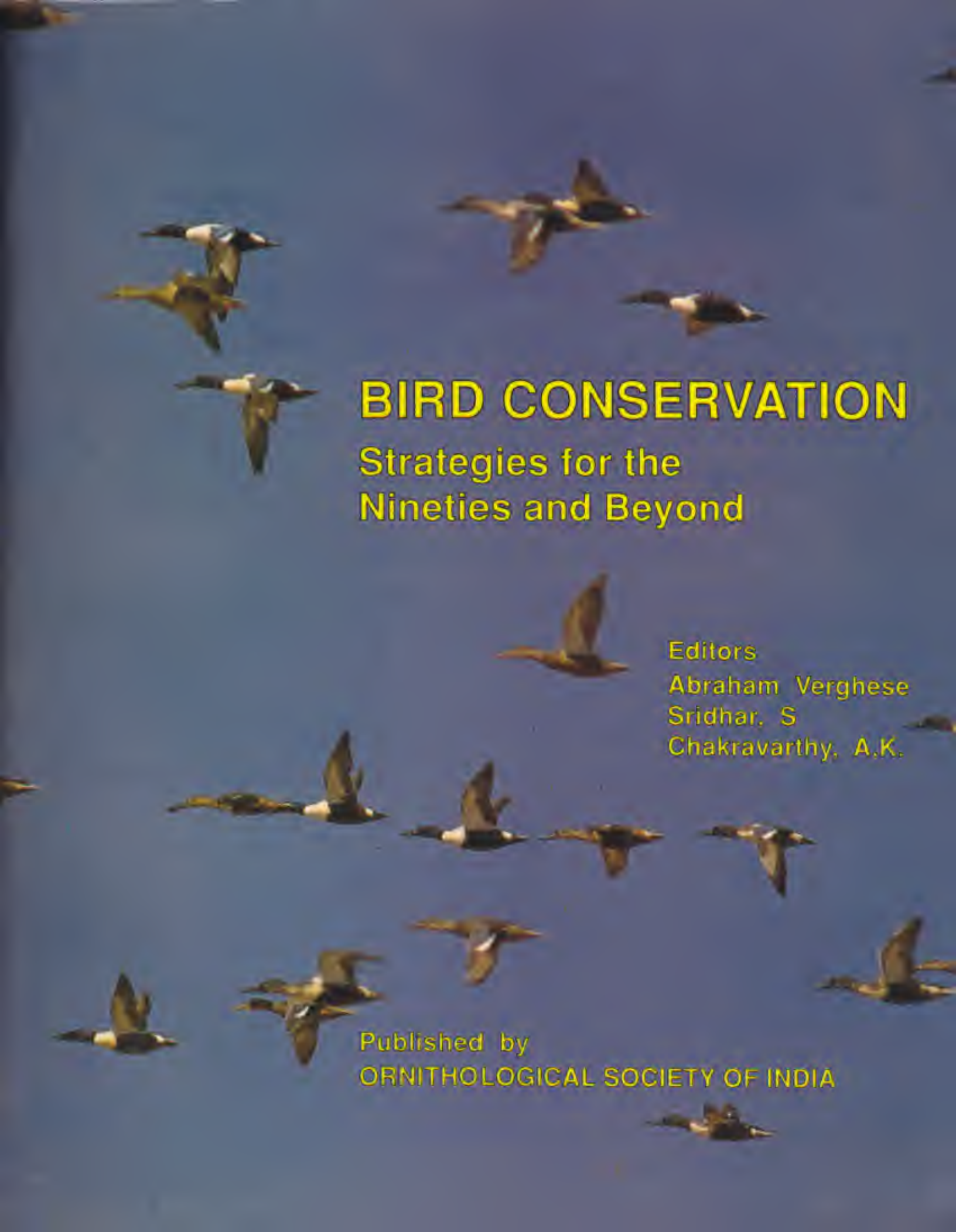

BIRD CONSERVATION

Strategies for the Nineties and Beyond

Editors
Abraham Verghese
Sridhar. S
Chakravarthy. A.K.

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Minutes of the meeting on held 12th May, 1993 at the Institution of Engineers in connection with the First National Seminar on **"CHANGING SCENARIO OF BIRD ECOLOGY & CONSERVATION"**, Bangalore (12-14 November 1993) under the Chairmanship of Mr. A.N. Yellappa Reddy, Special Secretary, Department of Ecology and Environment, Government of Karnataka.

The following Members attended the Meeting :-

01. **M O Sriram**
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02. **S Karthikeyan**, 24, Opp. Banashankari Temple, 8th Block, Jayanagar, Bangalore - 560 082
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03. **Vivek R Sinha**, 764, 100 Feet Road, IndiranagarBangalore - 560 008
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04. **Col R T Chacko**, A-301, Spartan Heights, 16, Richmond Road,Bangalore - 560 025
Ph. No. 215304

05. **K A Bhoja Shetty**, Kamala Mansion, 143, Infantry Road,Bangalore - 560 078
Ph. No. Off. 573206, Res. 642200

06. **S Sridhar**, No. 10, Sirur Park, 'B' Street, Seshadripuram,Bangalore - 560 020
Ph. No. Off. 364142,Res. 362927

07. **A N Yellappa Reddy**, Special Secretary Dept. of Ecology & Environment Multi-storied Building, Bangalore - 560 001
Ph. No. Off. 264377 Res. 630248

08. **A K Chakravarty**
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09. **M G Muthanna**
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Ph. No. 574705

10. **N A Madhyastha**, HOD Zoology, Poornaprajna College, UDUPI - 576 101

11. **M G R Rao**, Visvesvaraya Industrial & Technological Museum, Kasturba Road, Bangalore - 560 001
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12. **S Rangaswami**, Rishi Valley Bird Preserve
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13. **K Praveen Karanth**, No. 44, II Cross, Hospital Extension, Bangalore - 560 024
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14. **Smt. Usha Ramaiah**, 124, 42nd Cross, 8th Block, Jayanagar, Bangalore - 560 082
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16. **S R Surendra Babu**, P B No. 10, RamnagaramPin 571 511

17. **J N Prasad**, Merlin Nature Club, 13, 8th Cross, 30th Main, J P Nagar, I Phase, Bangalore - 560 078
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18. **Abraham Verghese**, 139, 2nd Main, Domlur, 2nd Stage, Bangalore - 560 071
Ph No. 573791

19. **S. Theodore Bhaskaran**
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Ph. No. Off. 265293,Res. 631337

The following members could not attend the Meeting. However many of them have informed about their willingness to be actively associated with the Seminar :-

01. **Pratap Surana**
155, 2nd Main Road,
Seshadripuram,Bangalore - 560 020
Ph. No. 366048

02. **L Shyamal**, D-206, IISc. Campus,Bangalore - 560 012

03. **J C Uttangi**
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04. **Boby Kovoor**
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05. **Arunachalam Kumar,**
Associate Professor of Anatomy,
Kasturba Medical College,
Mangalore - 575 001

06. **O C Naveein**, No. 5, William's Town
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07. **E Hanumantha Rao**
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08. **V G Prasad**,51/3, Maruthi
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Ph. No. 530880

11. **S Subramanya,**
326, Chitramala Apartments,Byrasandra
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Ph. No. 330153/Extn. 221

12. **G S Jayadeva**
Lecturer, Department of Zoology, J S S
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13. **T V N Murthy**
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14. **Satish Dhavan**, 7/11, Palace Cross
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15. **Joseph George**
100, 5th 'A' Cross, HIG Colony,
RMV II Stage, Bangalore - 560 094
Ph. No. Off 322207

16. **P D Sudarshan**, Soil Health Centre,
Sirsi, Uttara Kannada Dist. PIN : 581 401

The Chairman Mr. A. N. Yeliappa Reddy welcomed all the invitees, gave a brief introduction and outlined the importance of conducting this Seminar. Then he made the following announcements:-

a. The venue of the seminar will be Aranya Bhavan, (Malleswaram, Bangalore 560 003). The Principal Chief Conservator of Forest, has agreed to provide the requisite facilities at the venue.

b. Mr.S. Theodore Baskaran, Post Master General, Karnataka, has agreed to issue a special cover and cancellation to mark the occasion. An exhibition on bird philately, photographs and specimens will also be organised at the Visvesvaraya Industrial Technological Museum (VITM), Bangalore. The curator has agreed to provide the Exhibition hall, Display boards, Tables, Auditorium etc.,

c. Lunch, dinner and tea will be sponsored by the following organisations:

   1) Forest Department, Govt. of Karnataka,
   2) Karnataka State Forest Development Corporation,
   3) Karnataka State Forest Industries Corporation &
   4) Karnataka State Cashew Development Corporation.

d. Mid-seminar field trip will be to one or more of the sites in small manageable groups: Viz., Tailur Tank, Kokre Bellur Pelicanry, Kalkere Forest, Bannerghatta National Park and Ranganathittu Bird Sanctuary.

During the Meeting, with the proposal and consent of all the members present, the following committees were formed with specific duties as indicated against each :

1. RECEPTION COMMITTEE :

Chairman- K A Bhoja Shetty
Members - R T Chacko
S Karthikeyan
K Praveen Karanth
J C Uttangi
Duties - 1. To make arrangements for the inaugural function.
2. To arrange registration for the participants at the venue.

3. To make auditorium arrangements for Inaugural function and other sessions including plenary session.
4. To decide the Chief Guest, dais arrangement,Banner, Public Arrange System, Audio Visual Aid, Invitation, memento etc.

2. PROGRAMME COMMITTEE :

Chairman- Joseph George

Members- Abraham Verghese
S Sridhar
A K Chakravarthy

Duties -
1. To screen abstracts, Notes and papers received and allot them to appropriate sessions.
2. Tobring out the abstracts and proceedings of the seminar.
3. To decide on the Chairman and the Rapporteurs for different sessions.
4. To prepare and procure articles for the Souvenir.

3. SOUVENIR COMMITTEE :

Chairman- M G Muthanna

Members - Nagesh Hegde
Arunachalam Kumar
S R Surendra Babu
M O Sriram
Pratap Surana
T V N Murthy

Duties-
1. Collection of Advertisements and donations
2. Contacting M/s. Godrej, Birlas, Tatas, DCM, Mahindras & their Trusts/ Foundations for funds.
3. To approach Dharmadikari, Dharmasthala; Rural Development & Ecology Fund of Canara Bank; Vijaya Bank, LIC etc.,
4. To pursue with the Government Departments like CSIR, ICAR, UGC, DST, INSA, Department of Ecology and Environment, Government of Karnataka, etc., for financial assistance.

4. EXHIBITION COMMITTEE :

Chairmen - S Theodore Baskaran
V S Ramachandran

Members - M G R Rao
E Hanumantha Rao
Vivek R Sinha
Neerad Muthanna
Smt Usha Ramiah
S Rangaswami
B K Chakrapani
G S Jayadeva
R S Harvae

Duties -
1. To Organise exhibition on bird philately, photographs and specimens to coincide with curtain raiser and seminar.
2. Tobring out abrochure about the exhibits
3. To enroll volunteers for exhibition.

5. CATERING, TRANSPORT AND ACCOMMODATION COMMITTEE :

Chairman- Deputy Conservator of Forests
(Green Belt Division)

Members- ACF, Green Belt Division
Range Officers - Forest Dept., Aranya Bhavan
Estate Officer, Aranya Bhavan
O C Naveein

Duties- 1. To receive the delegates at Airport, Railway Station etc.,
2. To arrange for Boarding and lodging for delegates.
3. To oversee catering arrangements.
4. To arrange for TV, Chairs, Public address system, Audio-visual aids and operators etc.

6. PRESS AND PUBLICITY COMMITTEE :

Chairmen - Zafar Futehally
A N Yellappa Reddy

Members- Abraham Verghese
Arun Bhatia
P D Sudarshan
N A Madhyastha
Channa Nagaraj

Duties - 1. To arrange curtain raiser and press conferences and prepare press release.

7. MID - SEMINAR FIELD TRIP COMMITTEE :

Chairman - Abraham Verghese
Members- S Subramanya
M B Krishna
A K Chakravarthy
L Shyamal
K Praveen Karanth
J N Prasad
N Srinivasan
T S Srinivasa
U Harish Kumar

Duties- 1) To decide on the places to be visited and prepare a pamplet outlining the sailent features of each site and provide them to the participants.
2) To enlist participants for the trip to places of bird interest and conduct them in small manageable groups
3) to make transport and catering arrangemensts for the field trip.

BUDGET :

Members deliberated on the possible sources of funds and approximated a budget for Rs.1.05 lakhs. The projected expenditure would however be to the tune of Rs.1.2 lakhs.

The chairman requested the Souvenir Committee to try and make-up the deficit.

The Meeting closed with the Chairman thanking all the members for their participation and for their willingness to take-up responsibilities.

It was decided to hold the next meeting on **Friday, 11th June 1993 at 5.30 p.m.** The venue for this meeting will be intimated to all the members in due course. **(Bangalore Club)**

Chairmen of the Committees are requested to prepare brief reports about the progress made by them and present the same in the next meeting.

Please write to S Sridhar or Tel. 364142, 363927 and confirm your participation.

BIRD CONSERVATION
Strategies for the Nineties and Beyond

First National Seminar on

Changing Scenario of Bird Ecology & Conservation

Bangalore
12 -14 November 1993

Seminar Venue
Aranya Bhavan
18th cross, Malleswaram, Bangalore 560 003

Exhibition Venue
Visvesvaraya Industrial and Technological Museum
Kasturba Road, Bangalore 560 001

Convened by
Ornithological Society of India

in Co-operation with

Dept of Ecology & Environment, Govt of Karnataka
Forest Department, Govt of Karnataka
Visvesvaraya Industrial and Technological Museum
Karnataka State Forest Development Corporation
Karnataka State Forest Industries Corporation
Karnataka State Cashew Development Corporation
Rishi Valley Bird Preserve, Andhra Pradesh

Seminar Executive Commitees:

	Phone Nos	
Executive Committee Chairman		
A. N. Yellappa Reddy	264377 (off)	630248(res)
Reception Committee Chairman		
K S Bhoja Shetty	573206 (off)	642200(res)
Programme Committee Chairman		
Joseph George	322207 (off)	
Souvenir Committee Chairman		
M G Muthanna	574705 (off)	
Exhibition Committee Chairmen		
S Theodore Baskaran	631337 (res)	
V S Ramachandran	564563 (off)	
Catering, Transport and Accommodation Committee Chairman		
D S Ravindran	343464(off)	347765 (res)
Press & Publicity Committee Charimen		
Zafar Futehally	533684(res)	
A N Yellappa Reddy	264377(off)	630248 (res)
Mid Seminar Field Trip Committee Chairman		
Abraham Verghese	394356 (off)	573791 (res)
Seminar Liaison Office		
No. 10, 'Vishnu Chittam' Sirur Park 'B' Street, Seshdaripuram, BANGALORE - 560 020	364142 364682	362927 (after office hrs.)

List of Philatelists exhibiting Bird Stamps at the Exhibition Hall, Visvesvaraya Industrial & Technological Museum, Kasturba Road , Bangalore 560 001

1. Mr. Aravind N. A.
S/o, Dr. N. A. Madhyasta, Inchala, Durga Saw Mill Lane
Chitpadi, Udupi - 576101
2. Mr. Daniel Monthero
Library Asst, SMS College, Brahmavar - 576 213
Udupi Taluk
3. Ms. Lakshmi Rama Krishnan
Flat No L -3, (223) Kailask Apartments, 8th Main Road
Malleswaram, Bangalore 560 003
4. Mr. Radha Krishna, S
Near Saw Mill, Kaggalipura P.O. Kanakapura Road,
Bangalore South, 562 112
5. Mr. Ramaswamy
'Angeeras', 2924, 14th Cross K.R. Road
BSK 2nd Stage, Bangalore 560 070
6. Mr. Sukumar. D.
30, V Cross, J. P. LIC Colony, Jayanagar, III Block East,
Bangalore 560 011.
7. Mr. Yogesh Kumar Vora
59/11, SSI Area, 5th Block,
Rajajinagar, Bangalore 560 010

List of Participants for the First National Seminar on "Changing Scenario of Bird Ecology & Conservation, November 12-14 , 1993, Bangalore as on 1st Sept. 1993

1. Mr. AASHEESH PITTIE
14-7-370, Begum Bazar
Hyderabad - 500 012

2. Mr. ABDUL BASHIR, C.A.
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P.O. Gavi, Vandiperiyar
Kerala - 685 533

3. Mr. AHMED ABDUL AZIZ
'AZIZ BAGH', Sultanpura
Hyderabad - 500 024

4. Mr. AIYANNA, P.M.
Farm Cinchona Estate, P.B. No. 59, Kutta, Kodagu - 571 250

5. Dr. ANDREW ROBERTSON
2 St. Georges Terrace
Blockley, Moreton-In-Marsh
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6. Dr. ANNAMALAI, R. (I.F.S.)
Dean (Forestry)
Forest College & Research Institute,
Tamil Nadu Agricultural University,
Mettupalayam- 644 1301

7. Mr. ARATHI BELLIAPPA
Nanchi Estate, Kutta,
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8. Mr. ARAVINDA, N.A.
S/o Dr. N.A. Madhyastha
Indiana, Durga Saw Mill Land
Chitradi, Udupi - 576 101

9. Mr. ARDOP CHAUDHURY
C/o. Begha Jain P.O. Regent
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10. Mr. ARUMUGAM, G.
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11. Dr. ARUN KHER
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12. Dr. ASAD R. RAHMANI
Centre of Wildlife and Ornithology,
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Aligarh- 202 002

13. Mr. BALAKRISHNA P.
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UAS, GKVK, Bangalore - 560 065

14. Mr. BASAPPA S KOLLANAVAR
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15. Mr. BELLIAPPA K.C.
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16. Dr. BHAGWAT V.R.
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17. Dr. BHASKAR V.
Asso. Prof. Dept. of Farm Forestry,
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18. Dr. BHATNAGAR R.K.
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20. Mr. BIBHAB KUMAR TALUKDAR
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Regional Research Station,
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79. Mr. PERICHIAPPAN A.
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C/o Prof. Susan Bhaskar Rao
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Warangal-506 009

81 Mr. PRAHALAD V. CHALAGERI
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82. Dr. PRAKASH GOLE
Ecological Society
1B, Abhimanshree Society
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83. Mr. PRAKASH K. BHAT
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College Road , Sirsi- 581 402

84. Mr. PRAKASH RAO
K-4, QCH Colony, Sriharikota,
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85. Mr. PRAMOD P.
Research Scholar, Dept of Zoology ,Calicut University,
Kerala-673 635

86. Dr. PRARTHANA KATHURIA
Dept. of Genetics and Plant Breeding ,U.A.S. G.K.V.K.,
Bangalore- 560 065

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BIRD CONSERVATION

Strategies for the Nineties and Beyond

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Cover : A flock of shovellers (*Anas clypeata*) on their trans oriental migration (Photo S. Sridhar)

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PREFACE

This book is a collection of papers contributed to the "First National Seminar on Birds: Changing Scenario of Bird Conservation and Ecology", November 12-14, 1993, Bangalore. This is clearly a departure from the established norm of publishing a "Proceedings", after a seminar (i.e. where organizers are able to bring out one). The overwhelming response to the Seminar and the wealth of information on birds that kept pouring into the Seminar office, convinced us that it is only fair to disseminate these in print to all participants.

"Bird Conservation: Strategies for Nineties and Beyond", the title of this book, reflects the vision with which the organizing team worked. There has been no dilution of our original belief that amateurs, the major chunk of bird observers in India, constituted mainly by students, research scholars, scientists, and enthusiastic birdwatchers have to be brought on to a common platform with foresters, environmentalists and policy-makers to make viable bird conservation strategies operative. This book serves to cement these above categories of people and hopefully, as a catalyst to bird conservation movement in the oriental region.

In India, the field study of birds, even at a 'professional' level is more amateurish and qualitative. Many a times, inferences are from inadequate observations or analyses. We accept this since ornithology is still a growing field in India and we hope it will graduate to a professional level, wherein we can see more incisive studies on life-tables, population dynamics, predator-prey models, resource and foraging models, etc., from which precise conservation strategies can be drawn.

The task of editors was gigantic with nearly 1,500 pages of manuscript — the majority without adherence to our publication format. We have tried out best to maintain uniformity, clarity and brevity in all the manuscripts.

The views and inferences in the papers are solely the authors', and this book serves only as a medium of dissemination. It is divided into three sections, viz., 1. Ecology and Conservation, 2. Biology and Behaviour and 3. Economic Ornithology.

The editors on behalf of the Organizing Committee of this Seminar, commend the efforts put in by the authors. They are assured that this book will be of immense value to Government Officials (in the environment, forestry and agriculture sectors) research institutions, colleges and overseas conservation organizations. Also, we sincerely hope that it will stimulate more researches on birds, in many other directions, currently unforeseen by us.

We place on record the support extended by Mr. Zafar Futehally, President, Ornithological Society of India, who has been the spirit behind this Seminar; Mr. A.N. Yellappa Reddy, Special Secretary, Department of Forest, Ecology and Environment, Government of Karnataka for his encouragement and enthusiasm; Mr. Noritaka Ichida of Wild Bird Society of Japan for the financial support to the publication of this book; all the authors for sending their papers and notes.

Thanks are due to Ms. C. Amrutha, Ms. Chandra, Ms. Suma, Ms. Vijaya and Ms. N.S. Nagashree for their editorial, desk top publishing and secretarial assistance and Mr. R. Narayanaswamy for planning and printing the book.

We are thankful to several other individuals, NGOs and Institutions who have directly or indirectly helped us in bringing out this book in a short period.

12.11.1993

Editors

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ECOLOGY and CONSERVATION

A Decade of Conservation of the Great Indian Bustard (*Ardeotis nigriceps*) at Rollapadu Wildlife Sanctuary

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Introduction

During the International Symposium on Bustards held at Jaipur in 1980, apprehensions were raised that not more than 15 Great Indian Bustard *Ardeotis nigriceps* survive in the whole of Andhra Pradesh (Pushp Kumar 1980 Pers. comm.). This figure was based on a rough estimates collected by the Chief Wildlife Warden, and not on any actual sighting. In mid 1980s, the bustard was 'discovered in the grasslands near Rollapadu village in Kurnool district (Manakadan & Rahmani 1989). Since then, a number of conservation measures have been taken for the bustards at Rollapadu Wildlife Sanctuary . This paper makes an overview of the conservation measures of the pasts decade, the positive and negative results and discusses the future implications and suggest recommendations.

Study area

Rollapadu village is situated 18 km southwest of Nandikotkur (15° 58' N & 78° 18' E) on Nandyal road, in Kurnool district. It lies in the plains between the Nallamalai and Yerramalai ranges of the Eastern Ghats. The terrain is gently undulating with predominantly poor red soil. The habitat is a mixture of grasslands, light scrub, scattered trees, and crop fields. The main crops of the area are sorghum, cotton, groundnut, foxtail millet, redgram and sessamum.

The region of semi-arid with an average annual rainfall of 668 mm. Summer peaks at 42°C (April and May) and winters are mild (17°C). Details of the sanctuary are given by Manakadan & Rahmani (1989).

Conservation Measures

The following conservation measures were taken by the Andhra Pradesh Forest Department for the protection of bustards and other wildlife:

1. Protection to the bustard: Initially five watchers were appointed to prevent hunting of bustards. Two of the watchers belonged to a community that had traditionally hunted bustards and other wildlife in the area. These watchers were very knowledgeable about the behavior and movement of bustards. Presently, a forester, a guard and nine watchers are posted at Rollapadu Wildlife Sanctuary.
2. Establishment of core areas: Revenue land and some private lands were acquired by the Forest Department to establish core areas where human disturbance and grazing were curtailed. The purpose of these enclosures was to serve as breeding sites for the bustard to build-up its numbers. Three enclosures of 320 ha, 120 ha and 40 ha were established, and were demarcated by trench-sum-mound walls. For the last one decade these enclosures are serving as safe breeding sites of bustards.
3. Publicity and education: A publicity and education campaign through pamphlets, press releases, TV and roadside boards was launched by the Forest Department to highlight the plight of th bustard, An educational centre was set up at Rollapadu to provide information about bustards and grassland fauna to visitors. Through the concerted efforts of the Forest Department, the Nandikotkur Bus Depot adopted bustard as the mascot for its buses.
4. Declaration as a wildlife sanctuary: In 1989, an area of 614 hectares was declared as a wildlife sanctuary.

Results And Discussion

Positive aspects

1. Owing to protection and good publicity by the Forest Department, hunting of bustards has completely stopped in the sanctuary area and its immediate environs. However, in spite of this protection and good breeding success each year, the maximum number of birds sighted each season remains more or less the same (Table I) . This indicates that either the bustards are being hunted during the non-breeding season when they are subject to local movement, or the carrying capacity of the Rollapadu grasslands with regards to the bustard has been reached so birds are emigrating to other areas. However, we have no evidence that more bustards are being seen elsewhere. Movement of the bustard is an important aspect which should be studied after marking birds and by telemetry.
2. The bustard has greatly benefited from the setting up of enclosures. All the territorial cocks have their display grounds inside or just outside the enclosures, where human disturbance is minimum. Moreover, all the nest located during the last 10 years were laid in the enclosures. This is mainly due to lack of human disturbance, increase in food supply through habitat improvement, presence of necessary micro-habitats such as chick hiding and resting places, in contrast to

the grazing lands where egg and chick are fully exposed to natural elements. Many of the species mentioned in Table II have also benefited due to development of enclosures.

3. There is now an awareness of the bustard at local and state level due to publicity campaign. This has resulted in a positive attitude among locals for bustard conservation in particular and wildlife conservation in general. Tourists from within the state, other states and to a lesser extend foreign countries visit Rollapadu to see bustard and other wildlife. School children are brought from nearby areas to learn about nature conservation.

4. Declaration of a wildlife sanctuary on the Rollapadu grasslands has given more power to the Forest Department to managed the grassland and its wildlife. Now funds are released annually to improve tourist facilities and for habitat protection. Without acquiring the land and declaration of a sanctuary, it would have been difficult to manage the area.

Negative Aspects

1. Graziers complain of the loss of grazing lands for their sheep, goats and cows. Their protests have resulted in opening one of the core areas of 120 ha for grazing.

2. Continuous increase in the number of blackbuck have resulted in crop damage to certain crops, especially in the nearby fields. Farmers complain regularly about blackbuck menace but the Forest Department is yet to evolve a strategy to counter this problem.

3. The increase in the population of predators such as fox and wild cat pose a threat to the bustard. The fox is known to be a predator of bustard egg (Rahmani & Manakadan, 1987). In 1992 a nesting hen was killed by a jungle cat, and between 1988 and 1991, remains of two cocks were seen by watchers which were probably killed either by cat or by wolf.

Recommendations

The Rollapadu Wildlife Sanctuary is one of the smallest sanctuaries in India. Owing to its small size it is easy to manage, but his also makes it vulnerable to threats. If crop damage problem is left unattended, it will increase resentment among villagers and jeopardize the existence of the sanctuary. Similarly any further increase in predator populations will disturb the breeding hens. Hence constant monitoring and scientific management are necessary.

Reasons for the lack of increase of the bustard population over the years will have to be looked into. If it is due to poaching outside the sanctuary, then protection will have to be extended in a much larger area. If the carrying capacity has been reached, then more enclosures will have to be set-up.

Since the creation of more enclosures will conflict with the needs of the locals, it will be first necessary to encourage them to take other vocations like poultry, bee keeping, mushroom farming or some cottage industries with the necessary financial support and technical knowhow provided, so that there is less demand for grazing lands. Incentives for small families for villages near the sanctuary will also reduce the demand for land for human and human related needs.

Resentment among locals will further increase if blackbuck crop damage problem is not tackled immediately. As blackbuck is in Schedule I of the Wildlife (Protection) Act, 1972, allowing its shooting will need permission from the Central Government as well as some changes in the law. We suggest that a crop damage compensation scheme should be started by the Forest Department for few years to see the reaction of villagers. Secondly, every atleast 25% of the blackbuck population should be removed and relocated. However, if both these schemes fail, only then culling of blackbuck should be allowed. Total removal can be justified if the purpose of the sanctuary is 'bustard rehabilitation only', as was originally intended. Similarly, removal of culling of predators such as fox and jackal should be started on an experimental basis.

Lastly for the better management of the Sanctuary, it would be necessary to establish a Range Forest Office either at Rollapadu or Nandikotkur. At present, the ranger operates from the Sirsailam-Nagarjunasagar sanctuary, a good 180 km away. A forester (the head of the staff at Rollapadu) has officially very little powers, so a Range Forest Office at or near the sanctuary will result in better administration of the sanctuary.

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Table 1: Maximum number of Bustards recorded during the last ten years

Year	Cocks	Hens	Total
1984	—	—	38
1985	—	—	—
1986	17	12	29
1987	17	24	41
1888	24	21	45
1989	—	14	—
1990	—	21	—
1991	—	15	—
1992	14	16	30
1993	20	*	—

Note Cocks - from total counts during the flocking season

Hens - From number of nests

* Nesting on at the time of writing this paper (September 1993)

Table 2: Major fauna that have benifited from the conservation measures for the Bustard

Species		Population estimate		Remarks
Common Name	Scientific Name	1988	1992	
Black buck	Antilope cervicapra	17	c.200	
Wolf	Canis lupus	2-3	2-3	Breeds inside enclosure
Jackal	Canis aureus	_	_	Breeds inside enclosure
Indian Fox	Vulpes benghalenses	c.6	c.34	Breeds inside enclosure
Jungle cat	Felis chaus	-	-	Benefitted from increased vegetation cover and lack of biotic pressures
Blacknaped hare	Lepus nigricollis	-	-	Benefitted from increased vegetation cover and lack of biotic pressures
Common monitor Lizard	Varanus benghalensis	-	-	Benefitted from increased vegetation cover and lack of biotic pressures
Lesser florican	Sypheotides indica	6	6	Breeds in enclosure

Possible Impacts of Climatic Changes on Wetlands and Birds

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Introduction

There is increasing evidence that rising emissions of carbon dioxide, Methane and Nitrous oxide and other radiatively active gases will lead to an increase in the earth's surface temperature (Parry et al., 1990). There may be likely changes in the geographical distribution of existing patterns of climate. As a result, the composition of the ecosystems that exist in each climatic zone is likely to change. This will be disruptive to wetlands (Martin, 1990). The possible impacts of global climatic changes on wetlands and wetland birds is discussed in this paper. The anticipatory measures for waterfowl conservation and sustainable development are suggested.

Material and Methods

Review on the subject has been extrapolated with waterfowl as bio-indicators and suggestions have been advanced.

Results and Discussion

Expected climatic changes

If emissions of greenhouse gases continue at their present rates (Fig.1) computer model's of the earth's climate predict that global average surface temperatures will rise by (1.5 to 4.5°C) by the year 2050. The critical climatic changes projected for lower latitudes (0–30°N&S) are warming of about 1°C and increase in precipitation by about 5–10%. In a warmer world, the Intertropical Convergence Zone (ITCZ) would advance further northward into Asia and Africa. If this happens, rainfall in India would increase, but not necessarily in all parts of the country. According to the latest report of Intergovernmental Panel on Climate Change, 1992, the rainfall in India will decrease contradictory to the earlier report of Parry and Carter, 1990. Whether the rainfall will increase or decrease, wetlands will be affected. Rainfall could also be more intense in its occurrence, propagating flood and erosion. The short-footed wader birds. Stints *Callidris* spp., Little Ringed Plover, *Charadrius dubius* and Sandpipers of *Tringa* spp. would be more severely affected than long-legged waders like Blackwinged Stilt, *Himantopus himantopus*, Ruff, *Philomachus pugnax*, etc. Increase in potential evapotranspiration can be expected to accompany the increase in temperature. Marked water stress may occur in areas where there is no accompanying increase in precipitation. The Siberian Crane (*Grus leucogeranus*), a threatened species uses its enormous fleshy beak to dig in wet mud where it forages predominantly on the tubers of sedges and the fleshy roots of aquatic plants. If the mud is dry it is difficult for the cranes to penetrate the substrate. Siberian cranes require wide expanses of shallow water where root-tubers are plentiful (Archibald and Landfried, 1993). Disappearance of shallow wetlands is one of the main causes for the decline of Spot-billed Pelican *Pelecanus philippensis* (Johnson et al., 1993). It is interesting to know that in the Year 1987 which happens to be an El-Nino (Anamalous warming of the Pacific Ocean off the coast of Peru) year the South West Monsoon failed over India leading to dry conditions (Table 1).

Wetlands not only help to control floods but they are critical to biodiversity and to the life-cycles of many bird species. Due to the climatic changes some of the inland water bodies might enlarge in size and some might shrink or disappear altogether. The shrinkage of freshwater bodies either due to increased evapotranspiration of water or siltation leads to a decrease in bird numbers. For instance Waterfowl census in Kashmir Wetlands during 1992 revealed that in Mirgund and Hokera lakes, Pintail (*Anas acuta*), Common Teal (*Anas crecca*), Grey Heron (*Ardea cinerea*), Wigeon (*Anas penelope*), Mallard (*Anas platyrhynchus*), Gadwall (*Anas strepetra*), Redcrested pochard (*Netta rufina*) and White-eyed pochard (*Aythya nyroca*) decreased in numbers due to a lack of sustainable water level. Little Grebe (*Podiceps ruficollis*) in Dal lake left the wetland in February, 1993 as the waterlevel dropped (Asian Wetland News, 1993).

In Karnataka, South India, Waterfowl totals at 81 tanks counted every year between 1989–92 showed the lowest totals in 1991 following the lowest rains in that period (Fig.1-2).

Meteorologists warn that the semi-arid to arid regions of the world will be the most sensitive to climate change. The unregulated river systems in these regions of the world with inadequate development of basin storage will be especially vulnerable (Rao and Sinha, 1991).

The number of Demoiselle crane (*Anthropoides virgo*) in Gujarat, for example, shot-up following a bountiful rainfall, and in years when rainfall was below normal, cranes shifted to nearby Maharashtra and Karnataka (Fig.3) It may be noted that of the 9 resident, endangered species of waterfowl in India, habitats of 5 are in arid regions (Sridhar and Srinivasa, 1993).

The major effects would be felt near the coastal areas as the frequency and intensity of tropical cyclones is expected to increase, also the mean sea level could rise by about 30 to 50 cm (by the Year 2050, Fig.4).

Coastal ecosystems would be threatened by inundation, freshwater shortages and salt damages. These are fragile ecosystems and will have a direct effect on the inter-tidal zone ecosystems. The marshes would shift inlands. Some species of waders using the coast like Plovers (*Charadrius*

sp.), Storks (Species of *Ciconia*) might be affected by these transformations. Although mangroves are known to withstand tropical storms but they could also wither under intensified onslaughts of tropical storms. If this happens, majority of the fish species will be affected. This in turn would affect the piscivorous birds like Gulls (*Larus spp.), Terns (Sterna* sp.), Ducks (*Anas* sp.), Cormorants (*Phalacrocorax* sp.) and Darter (*Anhinga rufa*).

In the Mekong delta (Cambodia) it is reported that 45% of the Bertre province, 28% of Tien Giang province (GO Long area) and 50% of Travinh Province are affected by saline water intrusion leading to deltas becoming wastelands, which were once frequented by water birds. Deltas and intertidal ecosystems provide a lifeline for millions of migratory birds and so are crucially important. Further migratory routes may get affected as a result of changes in the geographical distribution of existing climates. In addtion to this higher temperatures in the greenhouse world would lead to higher metabolic rates in the birds which in turn could lead to reduced fat storage and consequently will affect migratory birds. (Peter Symens, 1993)

Some of the important wetlands in India are Point Calimere and Pulicat in the South, Bharatpur Bird Sanctuary in Rajasthan, Rann of Kutch in Gujarat, Harikepattan in Punjab, Bramhaputra Valley in Assam, and the Sunderbans in West Bengal. All these wetlands form a lifeline for resident and migratory waterfowl and waders in the Indian sub-continent. The major climatic factors and likely impacts on the waterfowl species to be most affected are indicated in Fig.5.

Conservation measures

In view of the global climatic changes our strategy of managing the wetlands and waterfowl must also be updated as follows :

1. Countries must work together as members of a global society to promote cooperation and closely collaborate with IWRB, AWB, BLI and other international organisations, in protecting wetland habitats for birds. The annual mid-winter waterfowl census conducted by IWRB since 1987 presently include 1862 wetlands (776 from India) of 30 countries in Asia, Australia and New Zealand. The census data is critically important for indicating the biological diversity, the actions required to protect and manage wetlands on a sustainable basis. Surely the Asian waterfowl census is the only way in which waterfowl populations can be monitored on a consistent basis. A careful and critical analysis of census data over a period would enable early predictions of the impact of global environmental changes on wetlands.
2. Wetlands need advanced monitoring systems, such as satellite remote sensing, Geographical Information System (GIS) etc.
3. It may be desirable to initiate studies using the technique of Genetic Engineering for transferring to desirable genotypes elongation genes from deep-water rices and sea water tolerance genes from Mangrove species (Swaminathan, 1991), so that paddyfields and mangroves continue to serve as habitats for waterfowl.

Possible impacts of depletion of ozone layer, acid rain, pollution with poisons and the loss of biological diversity of birds need to be studied in the context of wetland ecosystems.

Conclusion

There is no scientific doubt about the increasing concentrations of the greenhouse gases. Also, there is a near consensus on climatic change. Wetlands falling in the sub-tropical areas will be affected more than the tropical wetlands. In the tropical areas, coastal wetlands will be more affected. Wetlands in the semi-arid and arid regions will be the most affected. Environmental impact analysis for endangered species of Spoonbill, Pelicans, Cranes, Herons and Storks are urgently required.

Acknowledgement

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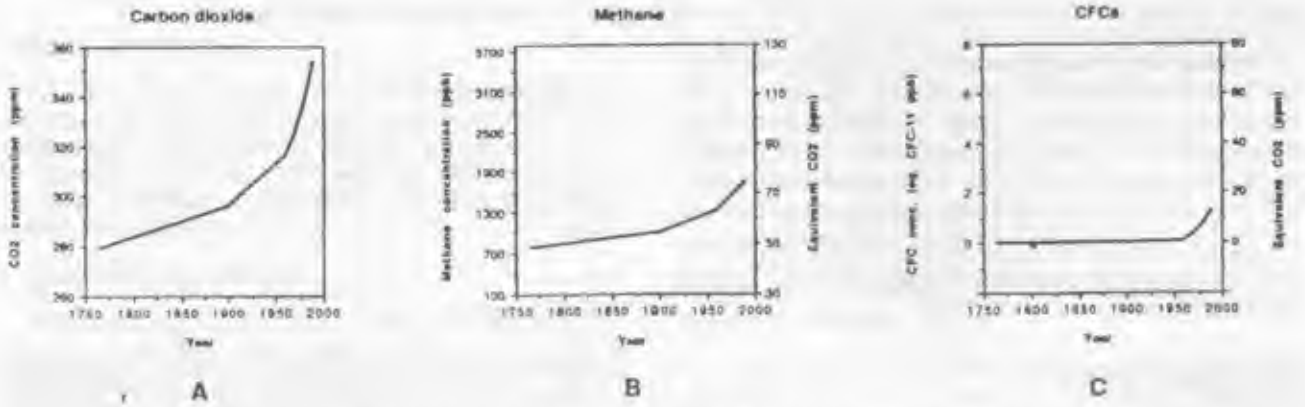
Table 1. World winterng population of Pelecanus philippensis

India (Johnson et al.)	1987	1988	1989	1990	1991	1992	1993
	345	1788	1931	2922	1410	2055	–

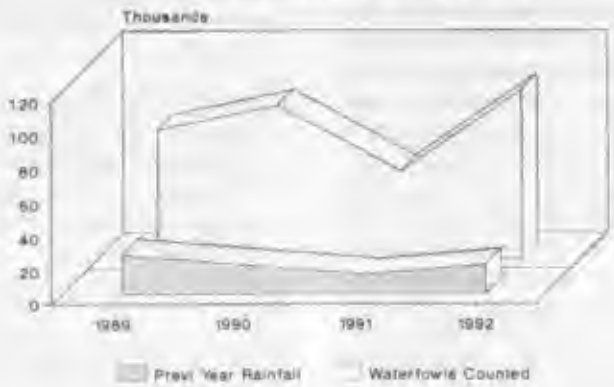


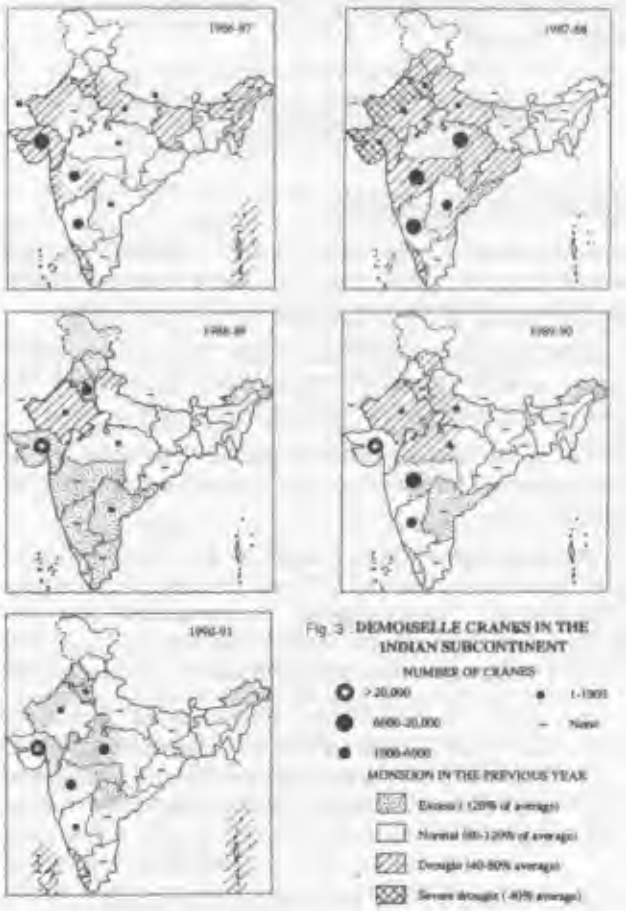
A – Concentration of carbondioxide since 1750. Almost all of the upward trend can be directly attributed to human activity.
B – Concentration of methane and effect of methane on radiative forcing in terms of CO_2-equivalent since 1750.
C – Concentration of CFCs, in terms of CFC11-equivalent and in terms of CO_2-equivalent.

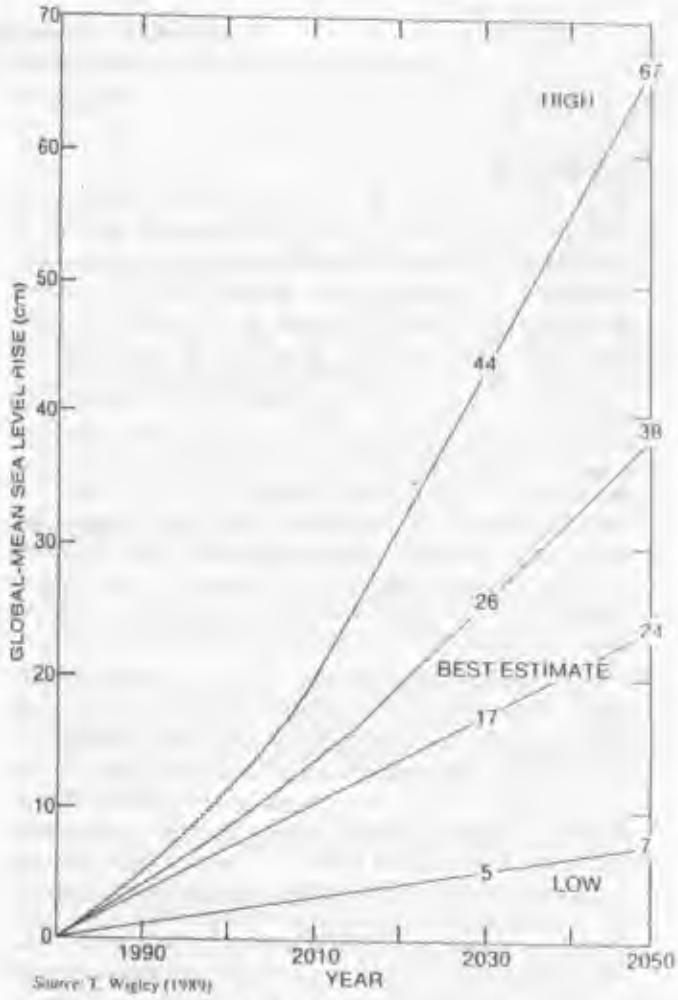
Source : Houghton et al, "Climate Change, the IPCC Scientific Assessment", Cambridge, 1990.

Fig.2 :

Waterfowl Population Trends in Karnataka
4 years data 1989 to 92, in 61 tanks







Source: T. Wigley (1989)

Fig. 4 : Projection of Sea Level Rise

Fig.5. Important wetlands for waterfowl in India and possible impact of climatic changes on wetlands and waterfowl.

Wetland area	Climatic changes/impact	Bird community to be affected
1. Rann of Kutch	Reduced rainfall and increased evaporation	Surface water feeders
2. Kerala coast	Not clear	Not much
3. Point Calimere	Increased sea level salt water intrusion	Surface water feeders
4. Pulicat lake	- do -	- do -
5. Sunderbans	Tropical storms, sea level rise	All communities
6. Bharatpur	Reduced rainfall and increased evaporation	Siberian crane and ducks
7. Harike Pattan	Reduced rainfall	Surface water feeders

Whitewinged Wood Duck (*Cairina scutulata*) : Viable Habitat Conservation in Assam

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Introduction

The White Winged Wood Duck (*Cairina scutulata*) of South- east Asia is the most endangered species of Anatidae in the world. The duck was described common throughout South-east Asia (Baker 1921), but later, Delacour (1959) described them as not rare, but never numerous. The historical data on *C. scutulata* are particularly good in India. The species was originally confined to North-east India mainly to Assam and Arunachal Pradesh (Green 1992), where it was abundant in parts. It is one of the largest duck species, with males slightly larger than females (Madge & Bunn, 1988). The duck has been the subject of various conservation measures since 1968 (Mackenzie & Kear, 1976). The duck is seriously threatened in its distribution range due to exploitation of the tropical forests on which they depend (Kear & Williams, 1978; Collar and Andrew, 1988).

The shy Whitewinged Wood Duck is very difficult to locate in natural habitats. The evergreen and semi-evergreen, moist deciduous and some patchy rain forests along with waterbodies of eastern Assam are the natural abodes of the duck. In Assam the duck is mainly observed in Dibru-saikhowa Wildlife Sanctuary comprising 650 sq km, Doomdooma Reserved Forest (RF) comprising 28 sq km, Joypoore RF comprising 108.69 sq km, Dangori RF comprising 9.2 sq km and Phillobari RF comprising 3.18 sq km (Talukdar and Bhattacharjee, 1993). Most of the areas where Whitewinged Wood Duck (WWWD) is found, is difficult to protect, because of extensive areas. So, to find habitats the duck prefers within sanctuaries or reserved forests of Assam, where conservation can be initiated, the present work was carried out.

Material and Methods

The study sites were the Dibru-saikhowa wildlife santuary (WLS) (27.40N, 95..24E) at 90-100 m altitude and Doomdooma RF (27.36N, 95.42E) at 100-150 m altitude, situated in the district of Tinsukia, Assam (Map 1 and Map 2).

The study was conducted during various seasons of two consecutive years. The data systematically recorded were-

1) Present and past reported sightings.
2) Types of disturbances to different habitats within the study area.
3) Vegetation types of different habitats.
4) Important plant species which are of vital importance as nesting trees.
5) Conditions of wetlands with special reference to the various forms of biotic interferences.

Results and Discussion

The present work was mainly confined to the identification of viable sites in Dibru-saikhowa Wildlife Sanctuary and Doomdooma Reserved Forest of Assam.

Dibru-Saikhowa Wildlife Sanctuary : Some of the salient plant species forming the forest composition of Dibru-saikhowa WLS are summarised in Table.1.

Among the above mentioned plants, *Salix tetrasperma*, *Mesua ferrea* and *Terminalis myriocarpa* were identified as nesting plants.

Dibru-saikhowa includes within its limit the merging of lofty Lohit and Debang Rivers to form the mighty Brahmaputra. The sanctuary is surrounded by the Brahmaputra River in the north and Dibru river in the south. The survey of the Dibru-saikhowa WLS showed that

a) There are three Forest Villages in the Sanctuary, viz - (i) The Ragbi Laika and (ii) Laika forest village situated in the North-west part of the sanctuary, and (iii) Dadhia forest village in the extreme South-west part of the sanctuary. During summer, when most part of the sanctuary is flooded, some villagers of Laika and Ragbi-Laika move on boat through the sanctuary in absence of any alternative route, which disturbs WWWD feeding locations and other wildlife.

b) The waterbodies in the WLS provide suitable habitat to WWWD. The ducks utilises selected waterbodies like beel - Kolomi, Dighali, Torali, Buri, Thekera and some selected areas in and around Nayanadi for resting and feeding.

c) The forest areas under Dighaltarang Beat of the sanctuary still have some primary forests which provides suitable cover for the WWWD.

Doomdooma Reserved Forest

The forest is dominated by *Mesua ferrea* and *Dipterocarpus macrocarpus*. The RF is situated on the north bank of Doomdooma River with Phillobari Tea Estate to the south and Bordubi Tea Estate to the south-west. The survey of the Doomdooma RF showed that

a) The WWWD is mainly spotted in "Littong" and "Kakopathar" forest range in the Doomdooma RF, and the areas have the capability of supporting breeding and feeding of WWWD.

b) Biotic interference is due to fodder and fuel-wood collection and grazing.

c) A portion of the RF is used for cultivation.

d) Fishing in the wetlands on a regular basis interferes with the various activities of the duck.

e) Logging reduces the number of nesting trees.

f) Egg collection, shooting and trapping of the duck is a direct hinderence to the population build-up.

Depending upon the frequency of spotting the WWWD in various sites in Dibru-saikhowa WLS and DOOMDOOMA RF, the following gradations were made (Table.2)

Valuation basedon available and observed spotting records on population size and habitat quality of the viable sites in the study area, is presented in Table 3.

Valuation based on the available and observed data on types of disturbances in the viable sites of the study area, is presented in Table. 4.

A rapid decline in the range of distribution and density of *Cairina scutulata* in India has been observed in the last four decades. At present the duck is mainly concentrated in some localised areas of eastern Assam apart from few areas of Arunchal Pradesh. From the present study and past records, it is evident that both Dibru-saikhowa WLS and Doomdooma RF are viable habitats for WWWD.

From the field observation, it could be distinctly seen that Doomdooma RF has higher habitat quality value (11 and 12 out of maximum 20) than Dibru-saikhowa habitat sites (4 to 11 out of maximum 20) which was the main criterion for conservation.

The present findings point out that the Doomdooma RF is the better site for the protection of WWWD for taking immediate protection measuress, including preventing biotic interferences. The immediate protection measures which have been initiated in collaboration with the Department of Forest, Govt. of Assam, are-

a) To upgrade the Doomdooma RF to the status of WLS - which automatically gets better protection from the adminstration.

b) A target oriented awareness programme to inform the value of conservation of this endangered species.

c) The WWWD should be declared as the State Bird for active protection.

d) Steps to be taken up to restore the degraded forest land.

e) A socio-economic survey on the fringe villages to be initiated to find out the causes of biotic pressure and estimation of dependence on the RF.

The success in the protection of Doomdooma RF with active cooperation and participation of all Government and non- government organisations of the area is at present the only long term conservation measure for WWWD (Deohah).

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Table 1 : Salient Plant Species of Dibru-saikhowa WLS.

Scientific name	Local Assamese name
Anthrocephalus cadamba	Kadam
Artocarpus chaplasha	Sam
Lagerstroemia acerifolium	Ajar
Terminalis myriocarpa	Hollock
Terminalis chebula	Hilikha
Terminalis belerica	Bhomora
Salis tetrasperma	Bher
Bombax ceiba	Simalu
Mangifera longipes	Urium
Mesua ferrea	Nahor
Stereospermum chelonoides	Paroli
Morus laevigata	Bula
Mallotus phillipinensis	Sundari
Alstonia scolaris	Sationa
Castanopsis sp.	Hingori
Dalbergis sisso	Sisso
Leea crispa	Kath-thengia
Garcinia sp.	Thekera
Arundo donax	Nal
Phragmites kakra	Khagori

Table 2 : Valuation of viable sites according to frequency of spotting

NAME OF SITES	GRADE	REMARKS
Doomdooma RF:		
"Littong Range"	3	Viable sites. Forest composition, habitat very suitable for WWWD
"Kakopathar Range"	4	Important viable site. Habitat suitable, needs better conservation and protection measures.
Dibru-saikhowa WLS:		
"Kolomy Area"	2	Viable site with water bodies. Disturbances due to movement of villagers.
"Dighali Beel"	1	Occasional visiting site. Disiturbances due to movement of villagers.
"Torali Beel"	1	Occasional visiting site. Biotic interference due to human activities.
"Buri Beel"	2	Viable sitie in Dighaltarang Beat. Suitable habitat. Disturbances due to illegal human activities.
"Thekera Beel"	3	Important site in Dighaltarang Beat. Habitat and the environment is very suitable for WWWD.
"Nayanadi Area"	2	Viable sites for WWWD as feeding and resting. Movement of boats creates disturbances.

*** 1 = Occasional, 2 = Moderate, 3 = High, 4 = Very high

Table 3 : Habitat Evaluation

Criteria for Valuation		Sites of importance to WWWD						
Criteria	Valuation Range	Doomdooma RF A	B	Dibru-saikhowa C	D	E	WLS F	G H
1. Population	(0-10)	4	5	3	2	1	2	32
2. Habitat Quality.								
a. Natural	(0-5)	4	4	2	2	1	3	41
b. Availability of Waterbodies	(0-5)	3	3	4	3	2	3	43
Maximum valuation	(0-20) Total:11		12	9	7	4	8	6

* Valuation of population is based on flock/group size.

** Valuation for Habitat Quality:
(based on cover, food.) 0 = Not suitable, 1 = Less suitable, 2 = Moderate, 3 = Suitable, 4 = Very suitable, 5 = Very much suitable.

*** A = "Littong Range", Doomdooma RF
B = "Kakopathar Range", Doomdooma RF
C = "Kolomy Area", Dibru-saikhowa WLS
D = "Dighali Beel", Dibru-saikhowa WLS
E = "Torali Beel Area", Dibru-saikhowa WLS
F = "Buri Beel Area", Dibru-saikhowa WLS
G = "Thekera Beel Area", Dibru-saikhowa WLS
H = "Nayanadi Area", Dibru-saikhowa WLS.

Table. 4: Disturbance Evalution

Criterias for valuation		Sites of Importance to WWWD						
Criteria	Valuation Range	Doomdooma A	B	RF Dibru-saikhowa C	D	E	WLS F	G H
1. Disturbances caused by :								
a. Fishing	(0-4)	2	2	1	1	2	2	13
b. Fodder & Fuel wood collection	0-4	3	3	1	1	2	2	14
c. Cutting of old matured trees	(0-4)	3	3	0	0	1	0	01
d. Movement of boats in summer (From April-October)	(0-4)	1	1	2	2	3	2	14

0 = Nil, 1 = Less, 2 = Moderate, 3 = High, 4 = Very high.

The Wetland Avifauna of Pulicat Bird Sanctuary, South India

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Introduction

There have been some studies on the coastal wetlands in south- east India in recent years (Krishnamurthy and Rao, 1970; Raman *et al.*, 1975; Sunderraj and Sanjeeva Raj, 1987). Little has been studied on the ornithological aspects of the wetlands in this region (Perennou and Santharam, 1990). Pulicat lake is one of the most important wetlands on India's eastern coast where hundreds of migratory waterfowls congregate on its vast mudflats every winter. Considering the importance of the lake for its natural resources, the areas was declared a bird sanctuary by the Andhra Pradesh forest department in 1976. As no detailed information is available on the avifauna of the area a study was undertaken between 1989 and 1992 to record the movement pattern, status and distribution of waterfowls in the sanctuary.

Material and Methods

Pulicat Bird Sanctuary (pbs) Is a vast brackish to saline lagoon with extensive mudflats. It is the second largest brackish water lagoon in India, with an area of about 450 sq km of which 84% lie in the state of Andhra Pradesh while the rest (the southern part) is in Tamil Nadu (Scott, 1989). The sanctuary lies in south coastal Andhra Pradesh (13 25' — 13 55'N, 80 03' — 80 19'E) and is shallow with large areas of mudflats. The spindle shaped Sriharikota island forms the eastern boundary of the sanctuary which separates the lagoon from the Bay of Bengal (Fig.1). Sea water enters the lagoon from the northern end and flows back into the Bay of Bengal from the southern side. The water regime at PBS is mainly dependent on the North-East monsoon and this has a prolonged effect on the salinity of the lagoon. The lagoon is virtually dry in the northern parts during summer (April–June). The N–E monsoon during October and November covers most of he sanctuary with water. The average annual rainfall for 1990 and 1991 was 1417 mm. Three major islands Venadu, Irukkam and Atakanithippa and several smaller islands and islets are seen in the northern part of the lagoon. The bulk of the waterfowl of the sanctuary is seen in the northern part along the Sulurpet-Sriharikota road which runs west to east through the sanctuary. There is little seasonal fluctuation in temperatures. Field studies were restricted to the accessible regions of the sanctuary. Most waterfowl concentrated in the northern half of the sanctuary. Hence, major field work was carried out here. Birds scientific name and listing is after Ripley, (1982) and Ali and Ripley (1987).

Censusing

In order to assess the population and movement of the waterfowl in the sanctuary the following method was adopted. A fortnightly total count of the main core area was taken along the Sulurpet-Sriharikota road, along a distance of 10 km which formed the main transect. A smaller transect of 2 km between Atakanithippa and Venadu islands was set to take regular counts of the Flamingo populations. During the counts, special emphasis was given to some of the larger species which acted as bio-indicators of the health of the wetland.

Banding

Extensive banding of birds was carried out in the coastal mudflats of the sanctuary. Birds were caught with the help of mistnets and clap traps. Each of these traps were placed along the shores of the sanctuary where there was good congregation of waterfowl. Netting was carried out at night for effective trapping. Each individual was ringed with a BNHS ring. Various measurements of the birds like wing, tail, bill, tarsus lengths, weight and moult were recorded and the bird released within 1–2 hours of capture.

Results and Discussion

The abundance of waterfowl fluctuates mainly with the prevailing water regime. The major groups of birds encountered were Storks, Flamingos, Ducks, Shorebirds, Gulls and Terns which formed the bulk of the waterfowl wintering in the sanctuary. From 1988 a regular waterfowl count was conducted as part of the Asian Waterfowl Census (AWC). The data obtained over the last five years indicated that Pulicat lake is a major wintering site for Palaearctic migrants (Table 1).

During the AWC of 1988, 83,806 waterfowl were counted at the sanctuary (the highest in the past five years) making it a wetland supporting the second largest concentration of waterfowl in India next only to Chilka lake in Orissa. It may be emphasized that both these wetlands are on India's eastern coast. A third very significant coastal wetland on the eastern coast is the Point Calimere Wildlife sanctuary in southern Tamil Nadu which also attracts vast numbers of migratory waterfowl. Together these three wetlands form part of a major migratory flyaway for migrant waterfowl in the Indian subcontinent.

A total of 88 species of birds associated with wetlands have been recorded from Pulicat Bird Sanctuary from the BNHS study. Of these 33 species (37.5%) are resident, and 55 species (62.5%) were palaearctic migrants. During the study, a total of 4012 birds of 50 species were banded from the sanctuary. The major families represented in the sanctuary included Pelicanidae (1sp), Phoenicopteridae (2 spp), Ciconiidae (6 spp), Anatidae (10 spp),Charadriidae (33 spp) and Laridae (9 spp).

Indicator Species

Three major families of waterbirds at PBS act as biological indicators of the quality of Pulicat lagoon. A major concentration of birds is seen during the migratory season (October–March) and it is this period which is useful in assessing trends in waterfowl populations (Fig.3).

Pelicanidae

Represented by one species the Spotbilled Pelican, (*Pelicans philippensis*), which is currently threatened, with populations existing mainly in a few wetlands in Andhra Pradesh and Assam. The sanctuary is a major foraging ground for the species which breeds in the nearby Nelapattu bird sanctuary. The Spotbilled Pelican is concentrated mainly in the northern and north-west region of Pulicat lagoon. Population figures show an increase in December, and decline from January as the water in the sanctuary recedes. A maximum count of 346 birds were recorded from the sanctuary during the AWC of 1992.

Phoenicopteridae

Two species are represented, the Greater Flamingo, (*Phoenicopterus roseus*) and the Lesser Flamingo, (*Phoeniconaias minor*). Of these, there is a significant population of Greater Flamingo at the sanctuary. Population trends suggest that the movement of the species is dependent mainly on the north-east monsoon. The core area of the sanctuary near Venadu island supports the maximum number of flamingos through the winter months. Over the years, numbers of the species have dropped due to commercial fishing. Around 4000–5000 birds have been recorded here regularly every year (Table 1). Lesser Flamingos are considerably fewer and they are usually seen in the core area adjoining Venadu island and not elsewhere in the sanctuary.

Anatidae

Ten species occur in the sanctuary of which eight are Palaearctic migrants. The anatids can be considered good indicators of the health of a wetland. Species wintering at Pulicat lagoon include Pintail (*Anas acuta*), Garganey,(*Anas querquedula*), Shoveller,(*Anas clypeata*),Common Teal,(*Anas crecca*), Wigeon,(*Anas clypeata*), Common Teal,(*Anas crecca*), Wigeon,(*Anas penelope*) and Gadwall,(*Anas strepera*). In recent years the Barheaded goose,(*Ansar indicus*) has also been represented in increasing numbers from the lagoon with 232 individuals recorded in January 1989 by Christian Perennou and V Santharam for the AWC (Hussain, 1990). Amongst ducks, Pintails constitute about 80% of the population with about 12,500 birds recorded during the AWC count in January 1991. All the duck species are seen in the northern half of the lagoon where the water recedes enabling large congregations to forage in extensive stretches of shallow water. The southern half of the lagoon attracts fewer species of ducks and other waterfowl due to the increased water level.

Charadriidae

The lagoon is one of the two major wetlands in south-east India for migrating shorebirds Prater *et al.*(1977) Due to the vastness of the lagoon only a rough estimate of the wader population was possible. The AWC count for 1991 showed about 16,000 waders for the sanctuary. This is however only an estimate as some inaccessible areas could not be surveyed. The current study has recorded 33 species of charadriids for the sanctuary. Most of the waders are distributed in the extensive mudflats along the Shriharikota–Sulurpet road and near Tada in the south-west part of the lagoon. The Little Stint(*Calidris minutus*) is the commonest wader. The lagoon held one of the largest concentrations of Avocet (*Recurvirostra avosetta*) occurring in south India (845 counted during the AWC of 1988). Species like Knot(*Calidris canutus*), Eastern Knot (*Calidris tenuirostris*), and Rednecked Phalarope (*Phalaropus lobatus*) are comparatively rare and are new records for Andhra Pradesh (Mohapatra and Rao, 1993). During the study, information on recovery of birds ringed was obtained from four birds of two species. One notable recovery was of a Polish Ringed Curlew Sandpiper (*Calidris testacea*) recovered from the mud flats of the sanctuary on 19.01.91. Subsequently it was known that the individual was banded in the Arctic Circle region of Russia. Recovery from Little Stint indicted that they were banded earlier in Point Calimere in Tamil Nadu and Kutch in Gujarat.

Two possible factors may explain the fewer number of recoveries from this wetland : i) Many sites remain unexplored in the lagoon due to limited access and ii) Due to changing wetland conditions in the lagoon there is considerable mobility in the waterfowl population. Extensive banding of waders from Pulicat sanctuary suggested that a large number of shorebirds used the lagoon as a major transient stopover on their way to other wetlands further south.

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APPENDIX 1
Wetland Avifauna of Pulicat Bird Sanctuary

*	Species		Status
	Little Grebe,	*Podiceps ruficollis*	R
*	Spotbilled Pelican,	*Pelecanus philippensis*	R
*	Little Cormorant,	*Phalacrocorax niger*	R
	Lesser Frigate Bird,	*Fregata minor#*	S
*	Grey Heron,	*Ardea cinerea*	R
	Purple Heron,	*Ardea purpurea*	R
	Large Egret,	*Ardea alba*	R
*	Pond Heron,	*Ardeola grayii*	RM
*	Cattle Egret,	*Bubulcus ibis*	R
*	Median Egret,	*Egretta intermedia*	R
*	Little Egret,	*Egretta garzetta*	R
	Reef Heron,	*Egretta gularis*	RM
*	Night Heron,	*Nycticorax nycticorax*	R
	Painted Stork,	*Mycteria leucocephala*	R
*	Openbill Stork,	*Anastomus oscitans*	R
	White Stork,	*Ciconia ciconia*	M
	White Ibis,	*Threskiornis aethiopica*	R
	Black Ibis,	*Pseudibis papillosa*	R
	Spoonbill,	*Platalea leucorodia*	R
*	Greater Flamingo,	*Phoenicopterus roseus*	M
	Lesser Flamingo,	*Phoeniconaias minor*	M
	Barheaded Goose,	*Anser indicus*	M
*	Pintail,	*Anas acuta*	M
*	Common Teal,	*Anas crecca*	M
	Spotbill Duck,	*Anas poecilorhyncha*	R
	Gadwall,	*Anas strepera*	M
*	Wigeon,	*Anas penelope*	M
*	Garganey,	*Anas querquedula*	M
*	Shoveller,	*Anas clypeata*	M
	Common Pochard,	*Aytha ferina*	M
	Cotton Teal,	*Nettapus coromandelianus*	PM
	Pariah Kite,	*Milvus migrans*	R
	Brahminy Kite,	*Haliastur indus*	R
	Whitebellied Sea Eagle,	*Haliaetus leucogaster*	R
	Marsh Harrier,	*Circus aeruginosis*	M
	Osprey,	*Pandion haliaetus*	M
	Peregrine Falcon,	*Falco peregrinus*	M
	Whitebreasted Waterhen,	*Amaurornis phoenicurus*	R
	Indian Moorhen,	*Gallinula chloropus*	R
	Purple Moorhen,	*Porphyrio porphyrio*	R
	Coot,	*Fulica atra*	RM
	Pheasant-tailed Jacana,	*Hydrophasianus chirurgus*	R
	Painted Snipe,	*Rostratula benghalensis*	R
*	Blackwinged Stilt,	*Himantopus himantopus*	M
*	Avocet,	*Recurvirostra avosetta*	M
*	Collard Pratincole,	*Glareola pratincola*	M
*	Redwattled Lapwing,	*Vanellus indicus*	R
*	Grey Plover,	*Pluvialis squatarola*	M
*	Eastern Golden Plover,	*Pluvialis dominica*	M
	Large Sand Plover,	*Charadrius leschnaultii#*	M
	Ringed Plover,	*Charadrius hiaticula*	M
*	Little Ringed Plover,	*Charadrius dubius*	M
*	Kentish Plover,	*Charadrius alexandrinus*	M
*	Lesser Sand Plover,	*Charadrius mongolus*	M
*	Whimbrel,	*Numenius phaeopus*	M
*	Curlew,	*Numenius arquata*	M
*	Blacktailed Godwit,	*Limosa limosa*	M
*	Spotted Redshank,	*Tringa erythropus*	M
*	Common Redshank,	*Tringa totanus*	M
*	Marsh Sandpiper,	*Tringa stagnatilis*	M
*	Greenshank,	*Tringa nebularia*	M
	Green Sandpiper,	*Tringa ochropus*	M
*	Wood Sandpiper,	*Tringa glareola*	M
*	Terek Sandpiper,	*Tringa terek*	M
*	Common Sandpiper,	*Tringa hypoleucos*	M
*	Pintail Snipe,	*Gallinago stenura*	M
*	Fantail Snipe,	*Gallinago gallinago*	M
*	Jack Snipe,	*Gallinago minima*	M
*	Knot,	*Calidris canutus#*	M
*	Eastern Knot,	*Calidris tenuirostris#*	M
*	Little Stint,	*Calidris minuta*	M
*	Temminckli's Stint,	*Calidris temminckii*	M
*	Dunlin,	*Calidris alpina*	M
*	Curlew Sandpiper,	*Calidris testacea*	M
*	Ruff and Reeve,	*Philomachus pugnax*	M
*	Rednecked Phalarope,	*Phalaropus lobatus#*	M
	Great Blackheaded Gull,	*Larus ichthyaetus*	M
	Brownheaded Gull,	*Larus brunnicephalus*	M
	Blackheaded Gull,	*Larus ridibundus*	M
*	Whiskered Tern,	*Chlidonias hybrida*	M
*	Black Tern,	*Chlidonias niger#*	M
*	Gullbilled Tern,	*Gelochelidon nilotica*	M
	Caspian Tern,	*Hydroprogne caspia*	M
*	Common Tern,	*Sterna hirundo#*	M
*	Little Tern,	*Sterna albifrons*	M
	Lesser Pied Kingfisher,	*Ceryle rudis*	R
	Common Kingfisher,	*Alcede atthis*	R
	Whitebreasted Kingfisher,	*Halcyon smyrnensis*	R

R — Resident, M — Migrant, RM — Resident-Migrant, S — Straggler

* – Species ringed during the current study

\# – New records for Andhra Pradesh

Table 1 : Waterfowl Population at Pulicat Sanctuary (1988–1992)*

	1988*	1989*	1990*	1991	1992
Number of species	*41*	*35*	*25*	*36*	*37*
Total waterfowl	83806	69871	38498	38722	10902
Indicator Species					
Spotbilled Pelican	27	89	274	42	346
Stork (3 species)	131	66	82	27	22
Flamingo (3 species)	5300	3100	5332	2200	3860
Ducks (7 species)	47397	21726	8831	17617	3400
Waders (33 species)	18363	42182	18609	16767	2289
Gulls and Terns (9 species)	25	820	298	576	128

** 1988–90 Figures taken from AWC annual reports, 1991–92 figures are from the current study.*

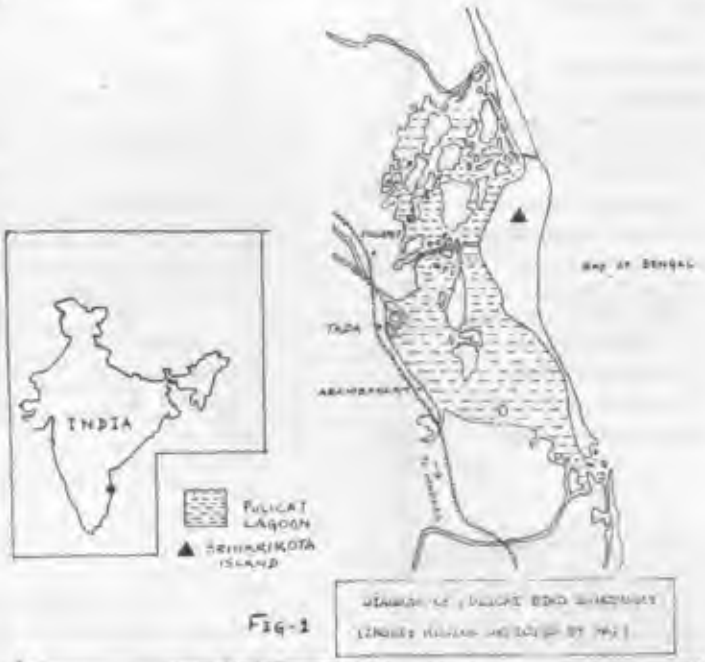
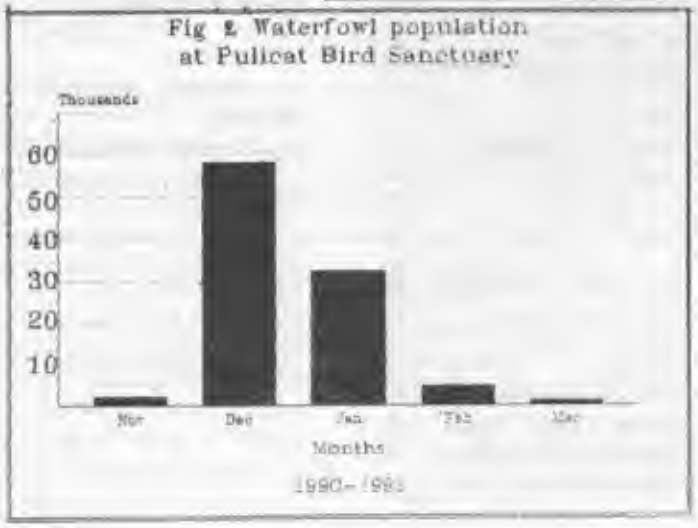


Fig-1



A Preliminary Study on the Bird Community of Silent Valley Area

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Introduction

A basic problem of field ecology is to determine the causes of abundance and distribution of organisms with relation to the environment. The aim of this work is to obtain some preliminary observations on the relationship between the vegetation structure and bird community in certain selected areas in the Silent Valley forest. The present study started in November 1992 and the data presented here is for six months. The bird community of different forests has been studied most intensively by McArther & McArther (1961), McArther & Peer (1962), and Cody (1966). Most of these studies were carried out in the forests of western countries and Africa. The forest bird community of South India has not been well studied.. Gaston (1980) and Ramakrishnan (1982) analysed the bird community structure with relation to vegetation in Silent Valley forest.

Material and Methods

Study area

The study area consisted of three sites of which one is inside the Silent Valley National Park and the other two near Mukkali, the nearest settlement. The Silent Valley National Park is one of the core zones of the Nilgiri Biosphere Reserve, in Palakkad district of Kerala. It lies between 11.3é and 11.5éN latitude, and 73.23'30 and 76.30éE longitude. The first site (site A) is at an altitude between 1015 m to 1100 m forest MSL and is a plateau with steep slopes on three sides. The other two sites (sites B & C) are at an altitude of about 600 m from the MSL. The vegetation of site A is the typical west coast tropical evergreen forest. Huge buttressed trees often reaching upto 40m is a characteristic feature of the site A. The common and dominant trees are *Palaquium ellipticum, Palaquium bourdillonii, Cullenia excelsa, Artocarpus heterophyllus, Calophyllum elatum, Canarium strictum*, etc. Site B is a secondary mixed moist deciduous forest. Trees reach between 20 to 40 m with abundant shrubby understorey vegetation. The common trees are *Terminalia paniculata, Terminalia tomentosa, Albizzia odoratissimia, Salmalia malabarica, Layerstomia lanceolata*, etc. In the understorey vegetation *Helictes isora, Cledodendron infortunatum* are common. Site C is a teak plantation. This a typical monoculture plantation with little ground vegetation.

Of the two methods : line transect (Haapanen, 1965; Emlen, 1964; and Gaston 1978) and point transect (International Bird Censusing Committee Report, 1960) the latter was chosen for cunsusing birds. The transects were predemined and each one was 2 km long, passing through almost all types of vegetation. The visibility was about 10 m on either side in site A, and 20 m and 40 m on either sides of the transects in sites B and C, respectively. The transect counts were made between 6.30 to 9.30 and 16.00 to 19.00. A pair of Carl Zeiss binocular of power 10 x 50 was used. Standard printed forms were used to note the data during the census. To avoid possible bias due to the differences in the time of observation alternate censuses in opposite direction were done.

Results and Discussion

The total number of species observed in each site during the study is given in Table 1.

Maximum number of species was observed in site B, a deciduous biotope. Abundance of shrubby, understorey vegetation along with the diverse plant species may be a reason for this increased number. The minimum number was in site C. This is a monoculture plantation, therefore absence of diversity of vegetation reduced available niches.

Number of species observed in each month is given in Table 2. This table shows the number of species in the site A during all the months was more or less constant. The maximum fluctuation in the number of species is in the site B and less in site A. This fluctuation may be due to the microclimate of the evergreen ecosystem which regulates itself to some degree, compared to the low land deciduous forest or any other biotope. Though the number of species in the plantation (i.e. site C) showed some fluctuation in these months, the data is not enough to make any conclusion.

The Table 3 shows the total number of individuals sighted in the 6 months of study in each sites. Though more species were sighted in site B, more individuals were recorded from site A. This may be due to the availability of food in the evergreen vegetation. Blossomheaded Parakeet, Small Green Barbet and Bronzed Drongo were the most common species present in all the three sites. The 7 raptors observed, were all from site A whereas only two from site B and one from site C. Frequency of Malabar Whistling Thrush and Black Bulbul was very high in site A. Thirteen species were common to all the three sites and 21 species were sighted only in site A. Thirty- two species were found common to site A and B, 36 species were found common to sites B and C and 21 species were found common to A & C.

Table 4 shows the change in the frequency of birds common in all the three sites.

Species diversity

Species diversity is related to the number of individuals in each species of a particular habitat. In this study diversity

index is calculated by the Shannon-Weaver method. According to this method

Diversity index $H = - P_i \log P_i$

P_i is the proportion of the individuals in the ith species of the total no. of individuals in the population.

i.e., $P_i = n/N$

Where n = no. of individuals in each species; and

N = total no. of individuals of that site

The diversity index calculated by the above method for the 3 different sites are given in Table 5.

Site B had maximum diversity where as the site C had the minimum. The deciduous biotope preserve maximum diversity compared to the evergreen biotope. But many endemic and very rare species were observed in the evergreen site.

Similarity : Similarity index is calculated from the number of species in each site and no. of species common to two sites, using the following formula

Similarity index (Sim) = 2C / A + C

Where

A=number of species in site 1

B=number of species in site 2

C=number of species common to sites 1 & 2

Similarity index calculated by the above formula is given in Table 6.

Similarity index value showed that site B and site C were more similar than the other two combinations. The main reason being that they are situated comparatively nearer. The next better similarity is between A and B, as both are natural forests.

This study is preliminary and in future, study of vegetation pattern of these three sites, including number of species, will be carried out. By studying the forest architecture and the phenological changes, site relationships with the changes in bird community structure can be understood.

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Table 1: Total Number of Species observed in each site

Site	A	B	C
No. of Species	57	65	39

Table 2 : Number of species observed each month in each site

Month	Sites		
	A	B	C
NOV	23	20	13
DEC	22	23	16
JAN	24	25	16
FEB	22	23	17
MAR	24	17	19
APR	22	18	18

Table 3 : Total number of birds observed in each site

Site	A	B	C
Total No. of Individuals	377	335	290

Table 4 : Frequency of Common birds in each site

Bird	Site		
	A	B	C
Blossomheaded Parakeet	29/72	18/72	25/72
Small Green Barbet	8/39	17/39	14/39
Great Goldenbacked Woodpecker	9/14	4/14	1/14
Bronzed Drongo	11/85	23/85	51/85
Black Drongo	10/43	22/43	11/43

Table 5: Species diversity of each site

Sites	$H = - P_i \log P_i$
A	- 3.433
B	- 3.5413
C	- 2.799

Table 6: Similarity Index

Sites	Similarity Index
A/ B	0.6666
B/ C	0.6923
A/ C	0.5246

Appendix List of Birds

Sl No	Common Name	Scientfic Name	Sites A	B	C
1	Black Winged Kite	Elanus Caeruleus	+	-	-
2	Honey Buzzard	Pernis ptilorhynchus	+	-	-
3	Black Eagle	Ictinaetus malayensis	+	+	+
4	Montagu's Harrier	Circus pygargus	+	-	-
5	Crested Serpent eagle	Spilorni cheela	+	+	-
6	Shahin falcon	Falco peregrinus	+	-	-
7	Kestrel	Falco tinnunculus	+	-	-
8	Painted bush quail	Perdicula erythrorhyncha	+	-	-
9	Travancore Red spurfowl	Galloperdix spadicea	+	-	-
10	Grey Jungle Fowl	Gallus sonneratii	+	-	-
11	Jerdon's imperial pigeon	Ducula badia	+	-	-
12	Emerald Dove	Chalcophaps indica	+	+	-
13	Spotted Dove	Streptopiia chinensis	-	+	+
14	Bluewinged Parakeet	Psittacula columboides	-	+	+
15	Blossomheaded Parakeet	P. cynocephala	+	+	
16	Roseringed parakeet	P.krameri	-	+	+
17	Malabar lorikeet	Loriculus vernalis	+	+	+
18	Malabar Owlet	Glaucidium radiatum	-	+	-
19	Redwinged Crested Cuckoo	Clamator coromandus	+	-	-
20	Jungle nightjar	Caprimulgus indicus	+	-	-
21	Green bee eater	Merops orientalis	+	+	+
22	Blue tailed Bee-eater	M. Philippinus		-	+
23	Great Hornbill	Buceros bicornis	+	-	-
24	Green Barbet	Megaliama viridis	+	+	+
25	Crimson breasted Barbet	M.haemacephala	+	+	+
26	Crimson throated Barbet	M.rubricapula	-	+	+
27	LessorGolden backed Woodpecker	Dinopium belgalense	-	+	+
28	Greater Goldenbacked Woodpecker	Crysocolaptes lucidus	+	+	+
29	Three Toed G.backed Woodpecker	Dinopium javense	+	+	-
30	Heart spotted woodpecker	Hemicircus canente	+	+	-
31	Mahratta woodpecker	Dendrocopos mahrattensis	-	+	-
35	Black headed Cuckoo shrike	Coracina melanoptera	-	+	-
36	Oriole	Oriolus oriolus	+	-	-
37	Blackheaded oriole	O.xanthornus	-	+	+
38	Black Drongo	Dicrurus adsimilis	+	+	+
32	India Pitta	Pitta brachyura	-	-	+
33	Redrumped swallow	Hirundo daurica	+	-	-
34	Large woodshrike	Tephrodornis virgatus	+	+	+
39	Bronzed Drongo	D.aeneus	+	+	+
40	Racket Tailed Drongo	D.paradiseus	-	+	+
41	Grey Drongo	D.leucophaeus	+	-	-
42	Common Myna	Acridotherus tristis	-	+	+
43	Jungle Myna	A. fuscus	-	+	+
44	Hill Myna	Gracula riligiosa	-	+	+
45	Tree Pie	Dendrocitta vagabunda	-	+	+
46	Orange minivet	Pericocotus flammeus	+	+	-
47	Common Iora	Agithenia tiphia	-	+	+
48	Fairy Blue bird	Irena puella	+	+	-
49	Goldfronted chloropsis	Chloropsis aurifrons	+	+	-
50	Rubythroat ed Bulbul	Pycnonotus malanicterus	+	-	+
51	Redwhiskered Bulbul	P.jacosus	+	+	+
52	Redvented Bulbul	P.cafer	+	+	+
53	Yellow browed Bulbul	Hypsipetes indicus	-	+	-
54	Black Bulbul	H. medagascariensis	+	-	-
55	Spotted Babbler	Pellorneum ruficeps	+	-	+
56	Jungle Babbler	Turdoides striatus	-	+	+
57	Blackhead Babbler	Rhopocincla atriceps	-	+	+
58	Greyhead Flycatcher	Xulicicapa cyclonensis	-	+	+
59	Verditer Flycather	Musicapa thalassina	-	+	-
60	Nilgiri V Flycather	M. albicaudata	+	-	-
61	Paradise Flycather	Terpsiphone paradisi	-	+	+
62	Black & orange Flycatcher	Muscicapa nigrorufa	+	-	-
63	Whitebellied blue Flycatcher	M.pallipes	+	-	-
64	Rufous tailed Flycatcher	M.ruficauda	+	-	-
65	Brown Flycatcher	M.latirostris	+	-	-
66	Blyth's reed warbler	Acrocephalus dumetorum	+	+	-
67	Tickell's leafwarbler	Phylloscopus affinis	+	+	+
68	Greenish leafwarbler	P. trochiloides	+	+	+
69	Franklin's wren warbler	Prinia hodgsonii	+	-	-
70	Ashy wren warbler	P.socialis	-	+	-
71	Orphean warbler	Sylvia hortensis	-	+	-
72	Blueheaded rock thrush	Monticola cinclorhynchus	-	+	-
73	Blue Rock Thrush	M. solitarius	-	+	-
74.	Whistling Thrush	Myiphoneus horsfieldii	+	+	-
75	Ground thrush	Zoothera citrina	-	+	+
76	Black bird	Turdus merula	+	+	-
77	Forest Wagtail	Motacilla indica	+	+	+
78	Grey Wagtail	M.caspica	+	+	+
79	Yellow wagtail	M.flava	+	+	-
80	Pied Wagtail	M.maderaspatensis	-	+	-
81	Thickbilled Flower pecker	Dicaeum agile	+	+	-
82	Tickell's Flower pecker	D.erythrorhychos	+	+	+
83	White throat	Sylvia curruca	-	+	-
84	Small sunbird	Nectarinia minima	+	+	+
85.	Purple Sunbird	N.asiatica	+	+	+
86	Purple rumped sunbird	N.zeylanica		+	+

Avifauna of Vembakkottai Water Reservoir — A Field Check List

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Survey of birds and preparation of checklist have been practised by naturalists to ascertain the status of bird populations in an area. In the present investigation an attempt has been made to survey the waterfowl and other birds of Vembakkottai reservoir situated about 15 km south of Sivakasi (9°27' N, 77°49' E).

The birds were counted during August and September, the last part of the monsoon, when the water level in the reservoir was about 1.5 m. The data obtained were classified and represented in the form of a checklist.

Check List

In the check list that follows the number in column (1) is the serial number and the number in column (2) is that in the *"Handbook of birds of India and Pakistan" ;common names and scientific names are given in column (3). In column (4) the status of the bird as recorded in the handbook is given.*

A few suggestions to conserve bird life here are as follows :

1. Prevention of tree (Acacia) felling for fuel by villagers.
2. Invasion of people (Srilankan refugees) to the northern side of the dam should be prevented.
3. Grazing of cattle should be avoided.
4. More islets should be provided in the western side for the birds to rest and feed.
5. Planting of trees to attract roosting of birds should be considered.

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Birds of Vembakkottai Water Reservoir Field Checklist

Sl No.	Hand Book No.	Name	No.	Status
1	21	Spotbilled or Grey pelican (*Pelecanus philippensis*)	157	R, LM
2	28	Little Coromorant (*Phalacrocorax niger*)	25	R, LM
3	29	Darter or Snake bird (*Anhringa rufa*)	3	*R, LM*
4	36	Grey Heron (*Areda cinerea*)	27	R
5	44	Cattle Egret (*Bubulcus ibis*)	6	R
7	60	Painted Stork (*Mycteria leucocephala*)	83	R, LM
8	61	Openbill Stork (*Anastomus oscitans*)	28	R, LM
9	69	White Ibis (*Threskiornis melanocaphala*)	22	R, LM
10	70	Black Ibis (*Pseudibis papillosa*)	106	R
11	72	Spoonbill (*Plataea leucorodia*)	13	PR, RM
12	97	Spotbilled duck (*Anas poecilorhyncha*)	56	R, CM
13	133	Pariah Kite (*Milvus migrans*)	10	R, C
14	135	Brahminy Kite (*Haliastur indus*)	2	R
15	140	Shikra (*Accipiter badius*)	3	R
16	311	Peafowl (*Pavo cristatus*)	77	R
17	370	Lapwing (*Vanellus malabaricus*)	35	R, IM
18	380	Little Ringed Plover (*Charadrius dubius*)	17	R
19	430	Blackwinged Stilt (*Himantopushimantopus*)	14	R, LM
20	600	Crowpheasant (*Centropus sinensis*)	2	R
21	720	Lesser Pied Kingfisher (*Ceryle rudis*)	4	R
22	736	Indian Whitebreasted Kingfisher (*Halcyon sunyrnensis*)	3	R, C, LM
23	756	Roller (*Coracias benghalensis*)	6	R, C, LM
24	916	Common Swallow (*Hirundo rustica*)	22	C
25	963	Drongo (*Dicrurus adsimilis*)	17	R, C
26	1006	Indian Myna (*Acridotheres tristis*)	32	R
27	1057	Jungle Crow (*Corvus macrohynchos*)	11	R
28	1891	Pied Wagtail (*Motacilla maderaspatensis*)	4	R, C
29	1938	House Sparrow (*Passer domesticus*)	9	R

R — Resident; LM — Local Migrant; PR — Partly Resident; PM — Partly Migrant; OM — Occasional Migrant; C —

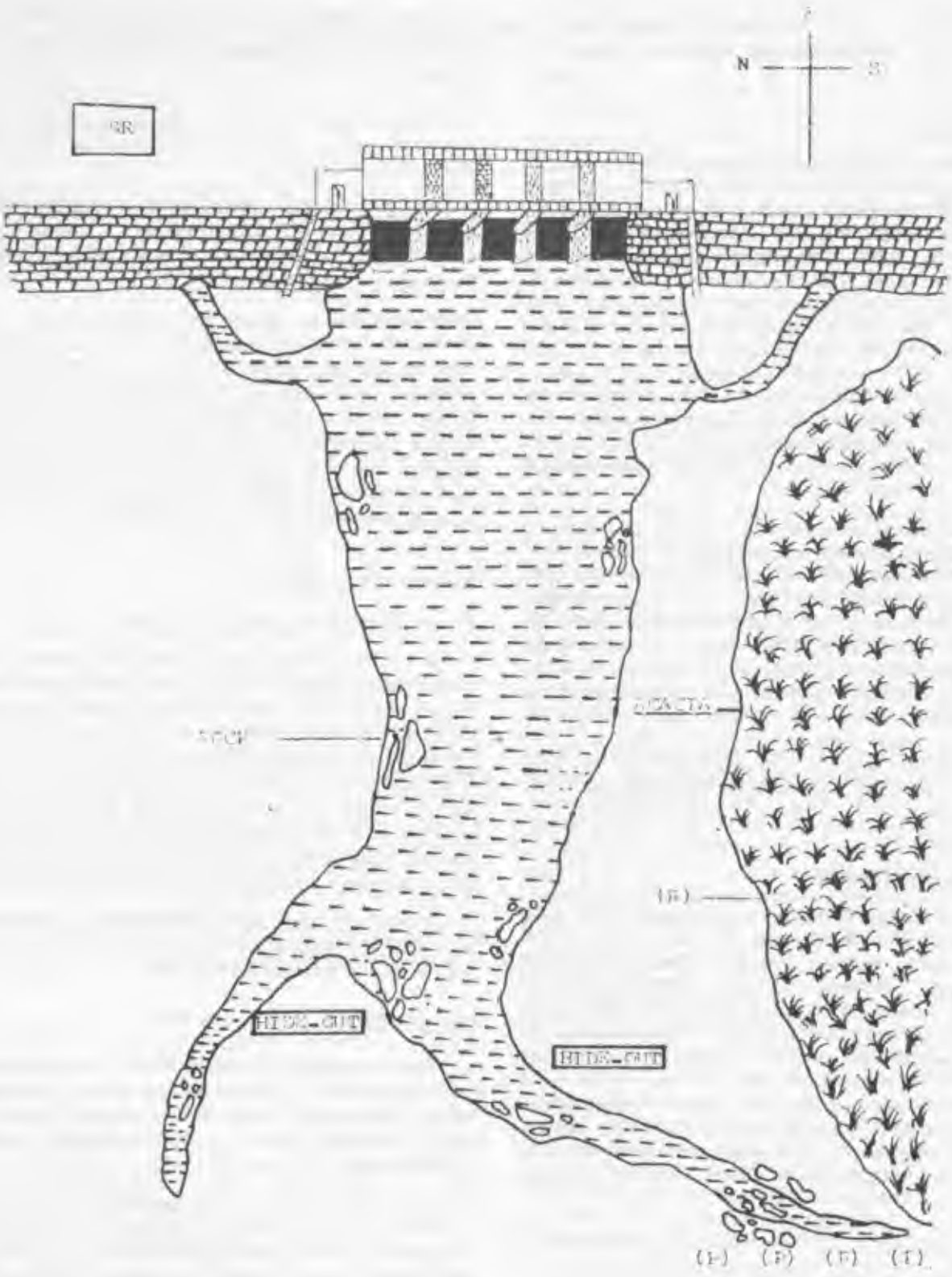

Figure 1.

Status, Diversity and Decline of Waterbirds in Brahmaputra Valley, Assam, India

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Introduction

Indian subcontinent represent 2094 forms belonging to 1200 species of avifauna (Ripley,1982; Ali and Ripley, 1983). This abundance and diversity of avian community obviously indicate the high ecological diversity of the country. The sub-continent represents marine, estuarine and inland wetland systems, which are all characteristically different. In contrast to the wetland compositions of other parts of the country, Assam represents only inland wetlands. The diverse aquatic ecosystems of India represent 417 forms (19.9%)belonging to 318 species (26.5%) and 146 genera (36.5%) of the avifauna of the sub-continent (Vijayan, 1986). The inland aquatic bird diversity of India is represented by 10 orders and 24 families and all of them are represented in the wetlands of Assam.

Some aspects of the avifauna of Assam, particularly on distribution, status and ecology are available (Hume, 1877, 1880, 1888; Koelz,1925; Parsons,1939; Betts, 1947,1956; Dey,1982; Ali and Ripley, 1983). Later, certain ecological aspects of the aquatic birds have been worked out by Raj *et. al*,1987, Saikia *et. al.*, 1987, 1988, 1989, 1990a, 1990b and Bhattacharjee *et. al.*, 1988. There is no comprehensive report on the status, diversity and conservation of the wetland birds of Assam. The present paper mainly deals with the present status of the wetland birds and their diversity in Brahmaputra valley. Emphasis was also given on the conservation problems of the wetland birds and their habitat.

Material and Methods

The Brahmaputra valley lies between 25°44'-28°N latitude and 89°41"E longitude. The valley covers 56274 sq km which includes the administrative districts of Lakhimpur, Dibrugarh, Sibsagar, Jorhat, Nowgang, Darrang, Kamrup, Sonitpur, Goalpara and Dhubri. The valley has Arunachal Pradesh and Bhutan on the north, Bangladesh on the west, the Meghalaya in the south, Nagaland in the south-east and the Tirap division of the Arunachal Pradesh in the east. The river Brahmaputra traverses through the valley covering more than 600 km. There is a marked difference between the north and south bank in its physiography. The valley is supported by a large number of tributaries of Brahmaputra in both the banks, which help in the formation of wetlands, oxbow lakes and huge marshy tracts. There are also dense forest covers in this tract. A significant characteristic of the Brahmaputra is the innumerable riverine islands. One such island is Majuli, the largest river island of the world. There are as many as 1394 registered and unregistered natural wetlands in Assam, the majority of which are in the Brahmaputra valley. Apart from the natural wetlands, there are a large number of artificial wetlands made by Ahom kings between 16th and 17th century. Some such wetlands are Jaysagar, Sibsagar, Gaurisagar, etc.

Climate of Assam is divided into four periods : winter (December-February), premonsoon (March-April), monsoon (May-September) and retreating monsoon (late September-November), Barthakur, 1966.

To determine the status and diversity and for the identification of the conservation problems, the wetlands were studied extensively throughout the Brahmaputra valley and the Brahmaputra river bed, from 1985 January to 1993 January. The condition of the wetlands, bird species diversity and human impact on waterbirds were recorded. The local inhabitants and traditional fisherman were interviewed to arrive at a conclusion regarding the trend and status of wetland and bird species.

Results and Discussion

Present Status Of Wetland Birds Diversity

From 1985 January to January 1993, the wetland bird survey has been carried out in 66 major wetlands selected on the basis of the high avifaunal diversity and high productivity in the Brahmaputra valley of Assam. Most of the wetlands are situated within the distance of 10 Km from Brahmaputra river except 5 man- made wetlands in upper Assam areas. The undisturbed and large productive wetlands were the richest wintering ground of migratory waterbirds, whereas the marshy and patchy wetlands supported large number of residential wetland bird species.

As many as 122 species of wetland birds of 19 families were recorded. Out of these 42 were rare, 17, very rare, 54 common and rest 9 abundant (Table I).

Status of wetlands

The present status of wetlands were determined on the basis of the level of eutrophication (whether cultural or natural); intensity of human activities; siltation; intensity of fishing; vegetation cover and natural calamities on the wetland ecosystems (Table II).

Most of the wetlands in the Brahmaputra valley are covered by phytoplankton and aquatic hydrophytes (Table-III). The human activity within and in the vicinity of the wetland included agricultural practices, fishing and creation of barricades. The other detrimental factors are the brick factories, encroachment for settlements, establishment of factories and construction of rails, roads and highway.

Human impact on bird species

Both direct and indirect human impact on the wetland bird species were detected. The direct adverse effect on the avifauna were the netting, killing , and trapping of birds throughout the year (Table-III),and the collection of eggs and chicks in the breeding season. The indirect effect were fishing and agricultural practices.

Ali and Ripley (1983) recorded 181 species of wetland birds in Assam. The present survey revealed the absence of 59 species of birds from the region, a reduction of 37.56% in a span of 40 years. Besides many species have become rare or threatened.

Of the 22 families which were recorded in earlier survey, the species from Phoenicopteridae, Haliornithidae and Dromadidae remained undocumented in the present survey. The higher number of species representing order, as per earlier reports, were Charadriformes (65 species); Anatidae(36 species) and Ardeidae (17 species). But at present in Charadriformes only 40 species were recorded, indicating a reduction of 23.76%. The number of species has been reduced by 50% in case of Rallidae, and 75% in other two families Threskiornithidae and Gruidae. The other family-wise reduction of the species number are Laridae (46.66), Alcidinidae (45.5%), Anatidae (27.7%), Accipitridae (25%), Ardeidae (11.1%) and Ciconidae (12.5%).

Most of the wader species population have shown declining trend in recent years. Apart from that,nine species belonging to this group, i.e.*Tringa terek viz.*, Numenius arquata, Numenius phaeopus, Scolopax rusticola, Ibidorhyncha stuthersii, Esacus magnirostris, Rostatula benghlensis, Vanellus spinosus and Vanellus vanellus are only rarely sighted. The Great Stone Plover, Eastern Curlew, Ibisbill and Eastern Whimbrel have considerably decreased and may disappear in near future. The only recorded places of these birds are Kurua beel of Kamrup district, Namari wildlife sanctuary and Brahmaputra river tract. The waders are easily trapped in mist nets laid in the shoreline of the beels and rivers mainly during winter. The breeding habitats and nests of the waders are destroyed due to agriculture and occasionally by wild and domestic animals.

Anatidae, the second largest wetland bird family in the region, is facing serious problems from various angles. The Pinkheaded Duck, *Rhodonessa cariophylaceae* which has been reported to be extinct and the Whitewinged Wood Duck, *Cairina scutulata* are in the verge of extinction from their natural habitats. The Cotton Teal,*Nettapus coromendalianus* has become highly localised due to destruction of nesting trees near water puddles. The Large Whistling Teal, *Dendrocygna bicolor* which has been declared as an endangered species by the Government of India protection act 1972, has declined at an alarming rate and could be sighted only in Majuli river island Panidihing, Bordoloni and in some patchy areas of eastern Assam. Apart from the residential birds, the migratory waterfowl *Anser anser, Anser indicus, Tadorna ferruginea and Anas crecca* are in great risk because of their table and market value. The distribution range of Barheaded Geese and Greylag Geese has shrunk and they are found in the Char area wetlands near Brahmaputra river of Kamrup, Sibsagar and Jorhat district. In large numbers they occur only in Kaxirange, Panidihing (proposed bird sanctuary) and Misamari beel. Incidently, goose hunting in Brahmaputra river tract is a lucrative sport. Of the 8 stork species recorded previously in Assam only 7 could be sighted in the present survey. The storks, *Ciconia niger, Ciconia ciconia, Ephippiorhynchus asiaticus* and *Ciconia episcopus* were found only in sanctuaries and national parks and in few small pockets of Jorhat and Lakhimpur district. The species of stork *Ephippiorhynchus asiaticus, Ciconia niger* and *Ciconia ciconia* have been included in the international endangered species list (King, 1981). The most urgent need of stork conservation is in South-East Asia where four of the globally threatened species are resident. The storks are very sensitive to their habitats, in general, as they are unable to adjust to sudden changes in habitat conditions (Curry- Lindahl 1978). The Adjutant,Greater and Lesser Storks were previously abundant in the Brahmaputra valley but due to destruction of their breeding and feeding habitats, they have become endangered.(See Wildlife protection act 1972 of the Government of India in Scheduled-I, Rahmani, 1989, and Luthin, 1987.)

In Threskiornithidae, four species were reported earlier but at present only Glossy Ibis,(*Plegadis falcinellus*) was present in the misamari beel (janjhimukh) of Jorhat district and Panidihing of Sibsagar district. In Gruidae, only one species *Grus grus* was sighted compared to 4 species recorded previously. This is mainly due to the disturbance factors prevalent in all the wetlands and sandy river bank. Occasional killing of the crane has also been reported.

The residential birds are also facing decline. The Ardeidae had only 15 species compared to 17 species recorded earlier. The Purple Heron ,*Ardea purpurea*, Grey Heron,*Ardea cineria* and Great Whitebellied Heron,*Ardea imperials* have become highly localised and the last one was found only once in Kaziranga and Pabitora wildlife sanctuaries. These three species have become very rare and require immediate conservation measures. The two species of jacanas were found in the wetlands of Assam but the Pheasant-tailed Jacana, *Hydrophasianus chirurgus* confined to the wetlands where Giant Water Lily, (*Eureale ferox*) were available. In the family Alcidinidae only 6 species have been sighted, out of 11 species recorded earlier. The Storkbilled Kingfisher, *Pelargops capensis* has been very rare and only could be found in Dibru-Saikhowa wildlife sanctuary, and the other species, *Ceryle lugubris* was sighted only in Namari wildlife sanctuary. The sole representative of Anhingidae, *Anhinga rufa* was sighted very rarely in low numbers.

Conservation problem of waterbirds

The susceptibility of aquatic avifauna population to changes in wetlands (Axell,1982; Vijayan,1986), have made them useful indicators of the ecological status of wetland ecosystem. The records of 122 species of wetland birds having diverse habitat requirement indicate that the wetland of Brahmaputra valley have potentialities to meet

the necessary life requisites. However,the species diversity of the wetland birds have declined in recent years. From the field study, a number of problems associated with wetland birds have been identified.

Alterations of habitat

The alteration of habitat is mainly caused by weed menace, silt and human interference within the wetland habitat. The most widely prevalent weed, *Eichhornia crassipes* is found to grow and cover every puddle of water, marshes, ponds and beels within the state, resulting in the shrinkage of open water and accelerating eutrophication. It was found that the increase in the open water space and habitat edges had a direct impact in the breeding activity of the residential birds as well as increased the number of winter visiting migratory birds. . Silt on the other hand has aggravated the main process of wetland eutrophication. The cultivation of Boro paddy on the beel margins and deforestation in the surrounding hills of the wetlands, led to the silting up of wetland beds. Apart from that, most of the beels are located by the sides of the hills, particularly in Western Assam where the forests of the hills are cut by settlers and timber smugglers, adding directly to the silting of wetlands. The feeding canals of the permanent wetlands are blocked by embankments construction which have led to the shallowing of the wetlands. In, slow flowing water, dense population of phytoplankton are symptoms of eutrofication (Moss, 1977). The extensive cultivation, fishing and silting from the river are also important detrimental factors of alteration of wetland habitat. The wetlands are now being converted into large human settlement areas, brick making factories, and rail and highway constructions.

Blird killing

The killing of the migratory and residential birds continue throughout the year in the wetlands and river beds of the State. For some traditional bird trappes, it is the only source of livelihood. The high demand for wild birds has led to the increase of bird trapping.

In rural areas the trapping of waterbirds are a regular phenomenon. Artificial lights, decoy traps, and spears are used. Besides, fishermen were also observed trapping birds like Painted Snipe, Woodcock, Lapwings, etc. Thus shooting and trappings are serious problems in wetland conservation.

Recommendations

Netting,trapping and shootingof waterbirds within the wetlands and Brahmaputra river tract must be stopped immediately.

Closed seasons should be declared. Regulated fishing should be advocated in the natural beel fisheries.

Some selected wetlands should be declared protected. In Assam not a single natural wetland is protected for the migratory birds. Local people should be educated on bird conservation and

Wildlife protection act. Fishing and agricultural practices near the wetland must be minimised.

Blockade of canals which feed the wetlands should be stopped.

Wetland and waterbird research should be encouraged.

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Table I: Wetland birds recorded in the present study and their status

Sl. No.	Family/ Scientific Name	English Name	Status	Remarks
A. PODICIPEDIDEAE				
1	*Podiceps cristatus*	GreatCreasted Grebe	r/RB	
2	*Podiceps ruficolis*	*Little Grebe*	c/R?	
B.PELECANDIDAE				
3	*Pelecanus philippensis*	*Spotbilled Pelican*	*r/RLM*	*Common in Kaziranga N.P., Orang W.L.S.*
4	*Pelacanus onocrotalus*	*Rosy Pelican*	*r/pv*	
c. PHALACROCORACIDAE				
5	*Phalacrocorax xarbo*	Large Cormorant	r/RLM	
6	*Phalacrocorax niger*	Little Cormorant	A/RLM	
7	*Phalacrocorax ruficolis*	*Indian shag*	*vr/RLMB?*	*Observed only in Manas &Diplai*
D. ANHINGIDAE				
8	*Anhinga rufa*	*Darter*	*r/RLMB*	
E. ARDEIDAE				
9	*Arde imperiah*	*Great Whitebellied Heron*	*vr/RB?*	*Pobitora & Manas*
10	*Ardea goliath*	Giant Heron	vr/v**	Reported only once in anas & Dipor beel
11	*Ardea cicinerea*	Grey Heron	r/RB?	
12	*Ardeapurpuria*	Purple Heron	r/R	
13	*Egrettaalba*	Great Egret	A/RLM	
14	*Egretta intermedia*	Intermediate Egret	A/RLM	
15	*Egretta garzetta*	Little Egret	A/RLM	
16	*Bubulcus ibis*	Cattle Egret	A/RLM	
17	*Ardeola baccuspi*	Chinese Pond Heron	c/RLM	
18	*Ardeola grayii*	Pond Heron	A/RLM	
19	*Nycticorax nyxtixorax*	Night Heron	c/RLM	
20	*Ixobrychus cinnamomeus*	Chestnet Bittern	c/RLM	During summer only
21	*Ixobrychus flavivollis*	Black Bittern	vr/RLM	in Dikhowmukh Brahmaputra river tract
22	*Gorsaschius melonolophus*	Tiger Bittern	vr/R	
23	Ixobrychun sinensis	Yellow Bittern	vr/RLM	
F. CICONIDAE				
24	*Anastomus oscitans*	Asian Openbill Stork	C/RLM	Largely breeding colony in Majuli Island
25	*Ciconia episcopus*	Whitenecked Stork	r/RLM	Orang&Majuli Island
26	*Ciconia ciconia*	Oriental White Stork	Vr/M	Kaziranga
27	*Ciconia niger*	Black Stork	vr/P?	Orang and Majuli
28	*Ephippiorhynchus asiaticus*	Blacknecked Stork	r/RLM	National par k& game sanctuaries Deepar be
29	*Leptoptilos dubius*	Greater Adjutant Stork	r/R	Urban garbage centres
30	*Leptoptilos javanicus*	Lesser Adjutant Stork	c/RLM	Wetland of some districts of Assam
G. THRESKIORNITHIDAE				
31	*Plegadis falcinellus*	Glossy Ibis	r/R	Panidihing & Jhanjmukh
H. ANATIDAE				
32	*Anser albifrons*	White Fronted Geese	vr/P	
33	*Anser anser*	Greylag Geese	C/M	
34	*Anser indicus*	Barheaded Geese	C/M	
35	*Dendrocygna javanica*	Lesser Whistling Teal	A/RLM	
36	*Dendrocygna bicolor*	Large Whistling Teal	r/R	
37	Tadorna ferruginea	Brahminy duck	C/P	
38	*Tadorna tadorna*	Common Shelduck	r/P	
39	*Anus acuta*	Pintail	A/P	
41	*Anus poecilorhyncha*	Spotbill Duck	C/R	
42	*Anus poecilorhyncha haringtoni*	Spotbill Duck	C/RB?	Only in eastern Assam(Jaysagar)
43	*Anus platyrhychos*	Mallard	/P	
44	*Anus strepera*	Gadwall	C/P	
45	*Anus clypeata*	Shoveller	C/P	
46	*Anus querquedula*	Garganey	r/P	
47	*Anus penelope*	Wigeon	C/p	
48	*Neta rufina*	Redcrested Pochard	r/P	
49	*Aythya ferina*	Common Pochard	C/P	
50	*Aythya nyroca*	Whiteeyed Pochard	C/P	
51	*Aythya fuligula*	Tufted Duck	C/P	
52	*Nettapus coromandelianus*	Cotton Teal	C/R	Highly localised

53	*Cairina scutulata*	Whitewinged Wood Duck	Vr/R	Kasijan of Kakopathar R.F. & Dibrusaikhowa W.L.S.
54	*Sarkidiornis melanotos*	Nakta	Vr/RB?	Observed once in Semina (Kamrup)
55	*Mergus merganser*	Eastern Merganser	vr/P	In Dhir beel
56	*Mergus albellus*	Smew	vr/p	-do-
I. ACCIPITRIDAE				
57	*Haliastur indus*	Brahminy Kite	c/R	Common in Western Assam
58	*Ichyophage ichthyaetus*	Greyheaded Fish-eagle	r/R	
59	*Icthyophaga nana*	Himalayan Greyheaded Fish-eagle	r/R	Lawkhowa W.L.S.
60	*Haliaeetus leucorythus*	Ringtailed or Pallas's Fish-eagle	C/R	Nests observed in Barpeta
61	*Circus aeruginosus*	Marsh Harrier	C/M	
62	*Pandion halialtus*	*Osprey*	*r/RLM*	*Dipor beel & Orang*
J. GRUIDAE				
63	*Grus grus*	Eastern Common Crane	Vr/MV?	Mujuli Island (Kamalabari)
K. RALLIDAE				
64	*Rallus aquaticus*	Indian Water Rail	r/R	
65	*Amaurornis phoenicurus*	Whitebreasted Waterhen	c/R	
66	*Amaurornis bicolor*	Elwe's Crake	r/R	
67	*Gallicrex cinerea*	Kora	c/RLM	
68	*Gallinula chloropus*	Indian Moorhen	c/R	
69	*Fulica atra*	Coot	c/M	
L. JACANIDAE				
70	*Hydrophasianus chirurgus*	Phesant-tailed Jacana	C/R	Common in Dipor beed
71	*Metophidius indicus*	Bronzewinged Jacana	c/R	
M. CHARADRIIDAE				
72	*Vanellus indicus*	Redwattled Lapwing	c/R	
73	*Vanellus cinereus*	Greyheaded Lapwing	c/P	
74	*Vanellus spinosus*	Spurwinged Lapwing	r/R	
75	*Vanellus vanellus*	Peewit, Lapwing	Vr/P	Panidihing
76	*Pluvialis fulva*	Eastern Golden Plover	r/P	
77	*Charadrius dubius*	Little Ring Plover	r/??	
78	*Charadrius placidus*	Longbilled Ringed Plover	r/P	
N. SCOLOPACINAE				
79	*Numenius arquata*	Eastern Curlew	r/P	
80	*Numenius phaeopus*	Eastern Whimbrel	r/P	
81	*Tringa stagnatikis*	Marsh Sandpiper	c/P	
82	*Tringa erythropus*	Wood Spotted Redshank	r/P	
83	*Tringa glareola*	Sandpiper	c/P	
84	*Xenus tarek*	Terek sandpiper	r/P**	Recorded in North Guwahati
85	*Tringa totanus*	Common Redshank	C/P	
86	*Tringa hypoleucos*	Common Sandpiper	C/P	
87	*Tringa nebularia*	Greenshank	C/P	
88	*Tringa ochropus*	Green Sandpiper	C/P	
89	*Calidris minuta*	Little Stint	C/P	
90	*Gallinago solitaria*	Eastern Solitary Snipe	C/P	
91	*Gallinago gallinago*	Common Snipe	r/P	
92	*Scolopax rusticola*	Woodcock	r/P	
93	*Eurynorhynchus pygmaeus*	Spoonbilled Sandpiper	Vr/pv/	
94	*Phalaropus lobalus*	Rednecked phalarope	/VP	
O ROSTATULIDAE				
95	*Rostratula benghalensis*	Painted Snipe	r/R	
P RECURVIROSTRIDAE				
96	*Ibidorhyncha struthersii*	Ibisbill	Vr/P	Observed only in Nameri W.L.S.
97	*Himantopus himantopus*	Indian Blackwinged Stilt	r/RB??	Observed jhanjimukh only
98	*Recurvirostra avosetta*	Avocet	r/P	Observed once in Brahmaputra river
99	*Esacus magnirostris*	Great Stone Plover	r/R??	Observed in North bank (Kamrup Dist.,) in the Brahmaputra river tract
Q. GLAREOLIDAE				
100	*Glareola lecta*	Small Indian Pratincole	C/BR	
101	*Glareola partincola*	*Large Indian Pratincole*	*c/B?*	
R. LARIDAE				
102	*Larus fuscus*	Lesser Blackbacked Gull	r/P	
103	*Larus ridibundus*	Blackheaded Gull	r/P	
104	*Childonias hybridus*	Indian Whiskered Tern	c/R	
105	Sterna melanogastra	Tern	r/P	
106	Sterna auranta	Indian River Tern	C/R	

107	Sterna acuticauda	Black bellied Tern	C/R	
108	Sterna fuscata	Sooty Tern	r/p	
109	*Sterna albifrons*	Little Tern	r/R??	
S.	**ALCIDINIDAE**			
110	*Ceryle rudis*	Lesser Pied Kingfisher	C/R	
111	*Ceryle lugubris*	Pied Kingfisher	r/R	Observed only in Nameri
112	*Alcedo atthis*	Small Blue Kingfisher	c/R	
113	*Alcedo meninting*	Blue- eared Kingfisher	c/R	
114	*Pelargopsis capensis*	Storkbilled Kingfisher	r/R	
115	*Halcyon smyrnensis*	Whitebreasted Kingfisher	C/R	
T.	**MOTACILLIDAE**			
116	*Anthus roseaetus*	Vinaceousbreasted Pipit	C/P	
117	*Anthus spinoletta*	Central Asian Pipit	C/P	
118	*Motacilla flava*	Greyheaded Yellow Wagtail	C/P	
119	*Motacilla citreola*	Yellowheaded Wagtail	C/P	
120	*Motacilla caspica*	Grey Wagtail	C/P	
121	*Motacilla alba*	Indian White Wagtail	C/P	
122	*Motacilla maderospatenssis*	Large Pied Wagtail	C/R	

ABBREVIATIONS :

C =	Common	P =	Passage migrant
A =	Abundant	P? =	Migratory status unknown
r =	Rare	B? =	Breeding not recorded
Vr =	Very rate	? =	Residental status unknown
M =	Migratory	** =	Newly recorded
LM =	Locally migratory	V =	Vagrant
R =	Resident	V? =	Previously vagrant but now regular winter visitor

TABLE II: Wetland condition of Brahmaputra Valley located in different districts of the region

S.L No	WETLAND	DISTRICT	STATE OF EUTROPHICATION
1.	Dhir beel	Dhubri	Natural
2.	Dhakra beel	-do-	Cultural
3.	Diplai beel	-do-	Cultural
4.	Rainy beel	-do-	Natural&Cultural
5.	Dahar beel	-do-	Cultural & Natural
6.	Jogra beel	-do-	Cultural
7.	Chandakhula beel	-do-	Cultural
8.	Chilar beel	-do-	Cultural
9.	Nowkhowa beel	-do-	Natural & Cultural
10.	Tariasara beel	-do-	Cultural
11.	**Sarashwar**	**-do-**	**Natural**
12.	Nandini	-do-	Cultural
13.	Doloni beel	Goalpara	Natural
14.	Tamranga beel	-do-	Cultural
15.	Urpod beel	-do-	Cultural and Natural
16.	Dhamor-rhijan beel	-do-	Natural & Cultural
17.	Hasila beel	-do-	Cultural
18.	Kumari beel	-do-	Natural & Cultural
19.	Moitilang beel	-do-	Cultural
20.	Podombari	-do-	Cultural
21.	Chakla beel	-do-	Cultural
22.	Naitora sautora -Pt 1	do-	Cultural
23.	**National sautora.Pt 11**	**Kamrup**	**Cultural**
24.	Ververy beel	-do-	Cultural
25.	Chandubi beel	-do-	Natural
26.	Kukurmara beel	-do-	Cultural
27.	Bildora beel	-do-	Natural and Cultural
28.	Dipor beel	-do-	Natural and Cultural
29.	Hugli beel	-do-	Natural and Cultura
30.	Baghmara beel	-do-	Cultural
31.	Ghorajan	-do-	Natural and Cultural
32.	Gorjan	-do-	Natural and Cultural
33.	Batha	-do-	Cultural
34.	Singimari	Nalbari	Cultural
35.	Kapla	Borpeta	Natural and Cultural
36.	Saulkhuwa	-do-	Natural
37.	Baghmara	-do-	Natural
38.	Hahchara	-do-	Cultural
39.	Akara	-do-	Cultural
40.	Bhella beel	-do-	Cultural
41.	Boira beel	-do-	Cultural and Natural
42.	Kukarjan	-do-	——
43.	Basimari	-do-	Cultural
44.	Koimari beel	-do-	Cultural
45.	**Goronga beel**	**Nowgoan**	**Cultural**
46.	Morijhanji beel	Jorhat	Natural and Cultural
47.	Boralimari	-do-	Natural and Cultural
48.	Kokilamukh	-do-	Natural
49.	Bogoriguri	-do-	Cultural and Natural
50.	Sengamari	-do-	Cultural
51.	Missamari	-do-	Cultural and Natural
52.	Lawjan	-do-	Cultural and Natural
53.	Gorkhowi	-do-	Cultural
54.	Digholi	-do-	Cultural and Natural
55.	Jelingitup	-do-	Cultural
56.	I.No. Kawlmari	-do-	Cultural
57.	**Nagabeel**	**Golaghat**	**Cultural and Natural**
58.	Golabeel	-do-	Natural and Cultural
59.	Dikhowmukh	Sibsagar	Natural
60.	Rudrasagar pathar	-do-	Natural
61.	Jerengapathar	-do-	Natural
62.	Joysagar tank	-do-	Natural
63.	Brahmputr rivertrack	-do-	- - - -
64.	Dighali beel	Dibrugarh	Natural
65.	Burhi beel	-do-	-do-
66.	Kutomi beel	-do-	Natural

TABLE III : Factor affecting conservation and diversity of wetland birds

wetland	%cover Aquatic hydrophyte	%culti vation	Bird killing (N1S1T1)	Fishing diturbance intensity
Dhir	10	30	N F F	+ +
Dhakra	25	75	M R R	+ + +
Diplai	50	35	M R R	+ + +
Ralny	75	80	M R R	+ + +
Dahor	10	40	N O O	+ +
Jogar	18	75	N O O	+
Chandakhula	30	80	H O R	+ + +
Chilar	35	95	LOO	+ + +
Nowkhowa	25	50	H F R	+ + +
Tariasora	35	75	L F O	+ + +
Sarashwar	30	40	M O R	+
Nandini	75	80	N F R	+ +
Doloni	15	25	N O R	+
Tamranga	50	60	M O R	+ + +
Hasila	50	50	M R R	+ + +
Urpod	90	60	M F R	+ + +
Dhamor-rhijan	60	40	L R R	+ + +
Kumri	33	60	M R R	+ +
Moltilang	75	30	L F F	+ + +
Podombari	80	60	M R F	+ +
Chakla	50	70	L F O	+ +
Naitora sautora	50	80	M R O	+ + +
Ververy	90	75	M R O	+ + +
Kukurmara	50	70	L R O	+ + +
Bildora	60	40	M R F	+ +
Dipor	35	50	MFO	+++
Hugli	90	50	NFO	+++
Gorjann	70	50	MFO	+++
Batha	60	50	MFO	++
Ghorajan	50	60	NFO	++
Singimari	60	40	MFO	+++
Kapla	70	40	RFR	+++
Saulkhowa	20	30	ROO	+++
Baghmara	40	60	ROR	+++
Hahchara	40	70	OFR	+++
Akra	55	60	ROF	+++
Bhella Beel	45	70	ROR	+++
Boira	50	65	ROR	+++
Kukarjan	60	10	MOR	+++
Basimarai	70	60	HOR	+++
Goranga	40	70	nfo	+++
missamari	60	70	mfr	+++
morijhanji	75	60	mfo	+++
gorkhowi	70	80	mff	+++
digholi	60	50	mrf	+++
jelengitop	60	80	mrf	+++
1 no kaowmari	20	70	hrf	+++
nogabeel	50	70	mfr	++
galabeel	50	75	mfr	++
dikhowmukh	50	60	mff	+++
R.Sagr Pathr	99	55	NFO	+
Jereng Pathr	50	50	NOO	+
Joysagar Tank	10	—	—	-
Brahmhaputra	-	1	HR	+

(N 1 S 1 T 1) N1 = Netting ; S1 = Shooting; T1 = Trapping
O: Occasional Practice; F: Frequent; R: Regular Practice
H: Carried out more Than 40 days
M: Carried out 20 - 40 days
L: Carried out less that 20 days
n: No activity
+++ = High; ++ = Moderate; + Low

Table IV: Percentage of species reduction in each family of wetland birds

Sl.	Family	Number of Species Recorded		Percent reduction
		Past	Present	
1	Podcipediae	2	2	0
2	Pelecanidae	2	2	0
3	Phalacrocoracidae	4	3	25
4	Anhingidae	1	1	o
5.	Ardeidae	17	15	11
6.	Ciconidae	8	7	12.5
7.	Threskiornithidae	4	1	75
8	Anatidae	36	26	27.7
9	Accipitridae	8	6	25
10	Rallidae	12	6	25
11	Gruidae	4	1	50
12	Jacanidae	2	2	0
13	Charadriidae	37	23	40.5
14	Rostatulidae	1	1	0
15	Recurvirostridae	5	4	20
16	Dromedidae	1	0	100
17	Haliornithidae	1	0	100
18	Phoenicopteridae	1	0	100
19	Glareolidae	2	2	0
20	Laridae	15	2	46.6
21	Alcedinidae	11	6	45.5
22	Motacillidae	7	7	0
	Total	181	122	

Frugivorous Birds and the Conservation of Dry Evergreen Forest

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Introduction

What interactions between frugivores and fruits characterise the different types of forest vegetation of India? What roles have frugivores played in the origin, dispersal and maintenance of different forests ? In this report we examine the relationship between birds and fruits of the Tropical Dry Evergreen Forest (TDEF) (Champion and Seth, 1968) TDEF was once a luxuriant low forest along the coastal plains of Andhra Pradesh and Tamil Nadu. Of an estimated 2,00,000 km^2 that can support this forest type only about 1% is now covered with vegetation which is in various stages of degradation (Gadgil and Meher–Homji, 1986).

Dayanandan and Christopher (1990) suggested that birds played a dominant role in shaping the present features of the TDEF. Recently, Narasimhan (1991) made an exhaustive study of the flora of Chengalpattu district, a region typical of the TDEF. Snow (1981) has given a world survey of tropical frugivorous birds and their food plants. The birds of this region and some aspects for their biology are known from publications and our own observations in relating fruits to frugivores we seek to outline the basic approach necessary to fully comprehend the long evolutionary relationships between birds and plants in the TDEF as well as other forest types of India.

Material and Methods

Fruits of the TDEF have been collected from different localities and analysed for their size, morphology, shape, pigmentation and pulp quality during the past five years.

Birds of this region are known from the publications of Siromoney (1971). Besides personal observations, information on birds that consume fruits was also obtained from Ali and Ripley (1968–74) and Ali (1972).

Results and Discussion

The Chengalpattu district has 1063 angiosperm species (Narasimhan, 1991). Of these, 808 are dicotyledons. About 82% of these dicots are native plants, the remaining being exotics. Of the 664 native dicots 180 are woody plants. In this study we have analysed the fruit-frugivores relationship as it occurs among the woody native plants. It is interesting to compare the present record of plants in this region with that of Meher-Homji (1974) who recorded a total of 127 plants typical of the TDEF including 103 woody plants.

Figure 1 summarises the characteristics of fleshy fruits in the district. 130 out of the 180 woody native plants (72%) possess fleshy fruits. These include 70 berries and 60 drupes. Pepos of cucurbits and syconia of Moraceae are included among the berries. Thus, the TDEF is characterised by 54% berries and 46% drupes. The predominant colour of the fruits is red (48%) followed by black or dark purplish fruits (31%). About 14% of fruits are yellow or orange in colour while a small fraction of 7% are pericarp or mesocarp while about 5 are large, hard and fibrous. Large quantities of fleshy fruits are produced by Ziziphus oenoplia, Allophyllus serratus, Ficus bengalensis, F.religiosa, F.amplissima, F.hispida, Benkara malabarica, Hugonia maystax, Tarenna asiatica, Securinega lucopyrus, Grewia rotundifolia, Azadirachta indica, Memecyuclon umbellatum, Flacourtia indica, Carmona retusa, Ehretia ovalifolia, Psilanthus wightianus and Dendrophthoe falcata.

Among the non-woody plants the following species provide abundant brightly coloured fleshy fruits: *Cissus vitigenia, C. quadrangularia, Cyphostemma setosum, Teliocora acuminata* and *Melothria maderaspatana*.

The following species do not possess fleshy fruits but display brightly coloured arillate seeds that might attract birds: *Drypetes sepiaria, Maytenus emarginatus, cadaba fruticosa*, and the introduced *Pithecellobium dulce*. The common non- woody climber *Abrus precatorius* has red seeds with a black spot but we have not observed birds swallowing these seeds.

Figure 2 displays distribution of size of fleshy fruits in the TDEF. 84% of the fruits are less than 2 cm in diameter while most fruits (72%) are less than 1 cm in diameter. Large fruits between 3 and 8 cm do occur but these are not always fleshy. Some of them are fibrous and others fairly hard for birds to feed on. Such large fruits that may be eaten by birds or most probably by bats are: *Crateva magna, Atalantia monophylla, Pamburns missionus, Pleiospermium alatum, Catunaregam spinosum, Gardenia residenifera* and *Ziziphus xylopyrus*. The fruits of *Morinda coresia*, and *Capparis zeylanica* are large in size and are readily consumed by birds. Large and brightly coloured fruits are also found among non-woody climbers such as *Coccinia grandis* and *Trichosanthes tricuspidata*.

Table 1 lists 20 common birds known to consume fruits in TDEF. The exclusively frugivorous Common Green Pigeon is a local migrant and not very common in this region. Among the birds that feed on fruits about 12 are residents while the Rosy Pastor, Large Cuckoo-Shrike and Blackheaded Cuckoo-Shrike are winter migrants. The families of birds that feed on fruits include: Columbidae, Cuculidae, Capitonidae, Oriolidae, Sturnidae, Corvidae, Campephagidae, Irenidae, Pycnonotidae and Muscicapidae (Timalinae). In comparison with the number of species of birds recorded in India (about 1200) Tambaram area, monitored over a period of 50 years, is known to have about 150 birds. Thus, only 20 out of 150 birds are actively involved in seed dispersal in this region.

However, these frugivores occur in abundance in this as well as most other regions of India.

Several authors have discussed seed dispersal and the relationship between fruits and frugivores in the tropics (Morton, 1973; Snow, 1971, 1981). Snow (1981) distinguished seed predators such as some pigeons and parrots and parakeets from legitimate frugivores. The latter digest pericarp or other soft parts of the fruit but void seeds without any damage either by regurgitation or defecation. Further, the legitimate frugivores could be specialised or unspecialised birds. The specialists feed on larger fruits rich in fats and proteins. The fruits of the nonspecialists are generally smaller in size, less nutritious, mostly consisting of carbohydrates stored in a watery fluid. Investment of resource in these fruits are considered to be less, resulting in abundant fruits that attract many different kinds of birds even to a single species of plant.

Considering that 72% of the fruits are less than 1 cm in diameter the TDEF appears to attract mostly unspecialised frugivores. Our initial analysis reveals that almost all these small fleshy fruits are rich in carbohydrates and do not store proteins or fats in any significant quantities. There appears to be no one to one relationship between a plant and a frugivore; fruits of a single species is consumed by different species of birds. Fruiting in the TDEF is observed in both wet and dry seasons which in turn is related to the occurrence of the southwest and retreating southwest monsoon regimes that characterise this region. Birds are attracted to fruits of *Glycosmis mauritiana* and *Hugonia mystax* in September while a large number of birds visit *Ziziphus oenoplia*, *Benkara malabarica* and *Allophyllus serratus* in January-February. Neem, *Grewia orbiculata* and *Lannea coramandelica* offer abundant fruits in the summer.

The larger fruits with harder pericarp mentioned above may be more likely consumed by bats rather than birds. We have observed bat consumption of *Pamburus missionis*, *Alalantia monophylla*, *Catunaregram spinosa*, *Gardenia resinifera*, and *Polyalthia longifolia*. Fruits of *Ficus benghalensis* are eaten by a variety of birds as well as bats. The TDEF once supported large number of *Manikara hexandra*, and *Chloroxylon swietenia*. These have now become very rare due to deforestation. The agents of dispersal of these fruits are now known. Indeed what now remains of the TDEF in about 1% of its original home might represent primarily those woody plants that were dispersed by unspecialised birds.

The woody components of the TDEF that we find today are likely to have survived because they possess fruits dispersed by a large number of unspecialised birds. These birds could carry seeds to short distances where the plants get established.

However, since most of the birds active in this region are found throughout India they could disperse seeds to successive sites and thus spread them over a large area. Most woody plants of the TDEF are also found in the adjacent deciduous and thorn forests.

That a number of seeds of the TDEF are dispersed by birds can be readily seen even today by the presence of plants such as Ficus and tamarind. Plants that grow, flower, and fruit in such niches include *Atlantia monophylla*, *Azadirachta indica*, *Capparis zeylanica*, *C.brevispina*, *Morinda pubescens*, *Securinega leucopyrus*, *Ziziphus oenoplia*, *Psilanthes wightianus* and *Sansevieria roxburghiana*.

A detailed study of frugivory may reveal evolutionary relationships that have characterised the birds and plants of the different forest types of India. The importance of birds in conservation of a vegetation type is clearly brought about by the example of the Madras Christian College Campus. The campus has been protected for nearly 60 years from encroachment and deforestation. This has resulted in the establishment of a secondary but rich vegetation primarily of plants of the TDEF in about 360 acres of land which was practically barren 60 years ago. It is possible to re-establish such vegetation merely by protecting a large area and allowing the task of introducing native plants to the birds.

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Table 1 : Frugivores observed in the tropical dry evergreen forest

1	Common green pigeon (*Treron phoenicoptera*)	LM-nc
2	Koel (*Eudynamys scolopacea*)	PR-c
3	Common Hawk Cuckoo (*Cuculus varius*)	PR-c
4	Piedcrested Cuckoo (*Clamator jacobinus*)	LM-nc
5	Coppersmith (*Megalaima haemacephala*)	PR-c
6	Golden Oriole (*Oriolus oriolus*)	LM-c
7	Greyheaded Myna (*Sturnus malabaricus*)	LM-c
8	Blackheaded Myna (*Sturnus pagodarum*)	LM-c
9	Rosy Pastor (*Sturnus roseus*)	WV-nc
10	Indian Myna (*Acridotheres tristis*)	PR-vc
11	House Crow (*Corvus splendens*)	PR-vc
12	Jungle Crow (*Corvus macrorhynchos*)	PR-vc
13	Tree Pie (*Dendrocitta vagabunda*)	PR-c
14	Large Cuckoo-Shrike (*Coracina novaehollandiae*)	WV-nc
15	Blackheaded Cuckoo-Shrike (*Coracina melanoptera*)	WV-c
16	Iora (*Aegithina tiphia*)	PR-c
17	Redwhiskered Bulbul (*Pycnonotus jocosus*)	WV-vc
18	Redvented Bulbul (*Pycnonotus cafer*)	PR-vc
19	Whitebrowed Bulbul (*Pycnonotus luteolus*)	PR-vc
20	Whiteheaded Babbler (*Turdioides affinis*)	PR-vc

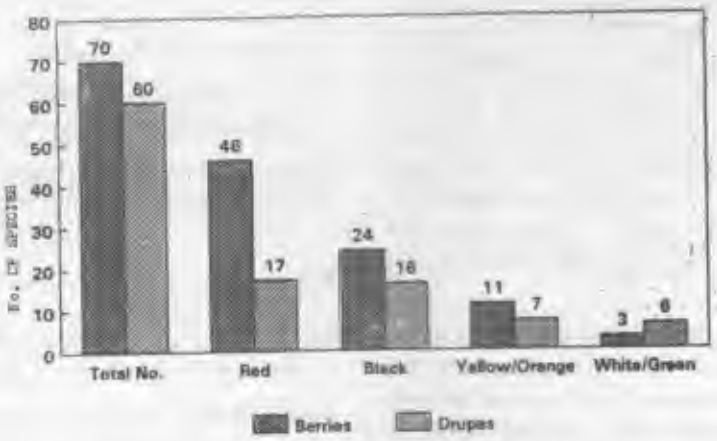

Fig 1 Colour of fleshy fruits in tropical dry evergreen forest

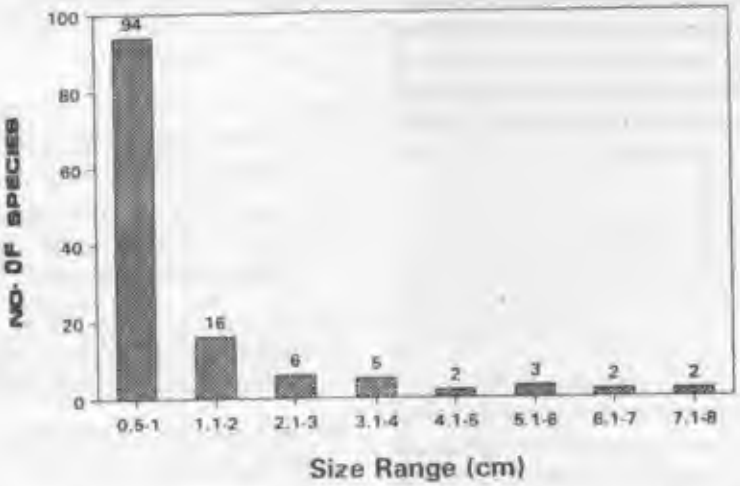

Fig.2 Size distribution of fleshy fruits in tropical dry evergreen forest

Conservation Priorities of the Whitewinged Wood Duck, *Carina scutulata* in India

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Introduction

The Whitewinged Wood Duck (WWWD) was common in parts of North- east India till the beginning of this century. Thereafter, there has been a steady decline in its population. In Dibrugarh and Lakhimpur districts of Assam its number declined from around 1900 to an estimated 44, (Green 1992). The main reason for their decline being the indiscriminate poaching/shooting and habitat loss.

Green (1992, 1993) has documented in detail the past and present distribution of this critically endangered bird and has also discussed various reasons affecting their population. I have had the opportunity of discussing the problems of WWWD with Dr Andy Green at Slimbridge in 1992 and in 1993 undertook a pilot survey to collect first-hand information on the status and habitat of WWWD in five key sites of Assam and Arunachal Pradesh (Tables 1 & 2). Two successive surveys were carried out between February (dry season) and May (wet season).

Material and Methods

The methodology has been described elsewhere (Yahya, 1993a & b) and findings are summarized in Tables-1 & 2.

Results and Discussion

It is encouraging that out of 65, now estimated from India (Green, 1992), we could see 26 and heard 8 (Tables 1 & 2) in about 40 days of intensive search. Maximum existing population of WWWD were seen in Doom Dooma and Dibru- Saikhowa WLS.

Although 3 key sites were surveyed in Arunachal Pradesh, no first hand report of any WWWD was obtained except calls of only one WWWD near M-Pen Nala in Namdapha Tiger Reserve. While some suitable habitats in D'Ering and Pakhui WLS were recorded, Mehao WLS should not be regarded as a key site now. While 65 WWWD estimated by Green from India may be an underestimation, a report of 200 pairs from Assam by the Forest Department is an over estimation. The present rough estimation of WWWD in both Assam and Arunachal Pradesh is around 100.

Habitats of the WWWD are severely depleted and nowhere it is 100 percent free from human pressure (Table 2). None of the sites visited has adequate number of trees suitable for nesting. Depletion and fragmentation of habitat and poaching of young/eggs appears to be the main reasons for such a low population of WWWD. Poaching and selling of adult WWWD are continuing. Choudhury (1993) cited one such case and I personally know several cases.

Arunchali Bheel is a suitable habitat for WWWD but quarrying selective logging and shikar by locals are common here.

WWWD may also get affected by diseases spread by affected WWWD from aviaries and Min Zoo, which escape and mingle with the wild population.

Owing to heavy use of chemicals in Tea Estates, the adjoining feeding habitats of WWWD may be polluted.

Conservation Priorities

— The first and foremost task is to save the existing habitats from further depletion and encroachment. Some sort of fencing has to be done at the vulnerable sites (such as Ubhata, Littong and Namholong).

— The second important effort should be to locate nesting pairs and protect the eggs/young from poaching. At suitable locations (such as Littong, Namholong and Digholtrang) artificial nest boxes can be supplied and monitored for long term study.

— More man power is needed to check all sorts of illegal activities in WWWD habitats. The Littong and Kakopathar Forest Range may be declared as WWWD sanctuary. Attempt should be made to modify/modernize the existing captive breeding centres and only healthy WWWD stocks should be maintained.

An intensive awareness campaign has to be launched to make the conservation plan of WWWD a real success.

Acknowledgements

I am grateful to the British Ecological Society, UK for a small grant under Grant No.985 and to Dr Andy Green (WWT Slimbridge) for encouraging the study. Several of the managers of William and Magor Tea Estate Company provided local help and hospitality during the field study.MrA. M. Khan, President, Assam Valley Wildlife Society arranged necessary permission for visiting Arunachal Pradesh and his suggestions during surveys were very useful. I am also indebted to Prof. A.H. Musavi, Chairman C.W.O. for allowing me to use some of the Centre equipment and to Dr Asad R. Rahmani for peer referring drafts. Mr Rashid H. Raza and a number of officials and field staff of the Assam & Arunachal Pradesh Forest Departments were helpful.

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Table 1. Sight records of white winged Woodduck in parts of Assam and Arunachal Pradesh

Sl. No.	Location	Habitat
1.	Colony, Guijan Range, Dibrusaikhowa WLS, Tinsukia Dist. 27.34 N 95.20 E	River tributory
2.	Littong Forest Beat Block 4, Doom Dooma, 27.36 N 95.42 E	Secondary evergreen forest
3.	Namholong, Littong Beat, Doom Dooma, 27.36 N 95.42 E	Secondary evergreen forest
4.	Ubhata Kakopathar Forest Range, Doom Dooma, 27.35 N 95.41 E	Secondary evergreen forest
5.	Koliapani Bheel Digholtrong Range, Dibro-Saikoja WLS, Tinsukia, 27.38 N 95.26 E	Swamp
6.	Boori Boori Bheel-Dighaltrong Range, Tinsukia Dist., 27.38 N 95.21 E	Secondary evergreen forest

Table 2. Call records of white winged Woodduck during 1st and 2nd phase survey

Location	Habitat
1. Littong Forest Range, Doom Dooma, 27.36 N 95.42 E	Secondary evergreen forest
2. Koliapani Bheel, Digholtrang Range	Swamp
3. M. Pen Nala, Namdapha Tiger Reserve	Secondary evergreen forest

Population and Wetland Habitat Preference of Waterfowls at Kota

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Introduction

Asian mid-winter waterfowl census is trying to assess the large scale trends in population changes, in species distribution and identification of important wintering sites of migratory and resident waterfowls in the Indian subcontinent. After seven years, still large gaps exist in the census data as central and eastern India is poorly represented in the counts. This study is the first effort towards assessment of monthly population fluctuation of resident and migratory waterfowls with their preference of habitat in Kota area of South West Rajasthan. The importance of such data has been emphasized by Vijayan (1986) to assess the relative importance of artificial wetlands supposed to be adequate substitutes for the vanishing natural ones. Information available on the birds of Kota was meagre, therefore this study was undertaken.

Material and Methods

The study area is situated on the western end of Malwa plateau and forms a part of South East Rajasthan which comprises the districts of Kota, Baran, Jhalawar, Chittaurgarh and Banswara. Kota and Jhalawar area consists of stony uplands but the Chambal river and its tributaries have formed an alluvial basin in the parts of Kota and Baran district. This area occupies some 13000 km^2, with roughly, the same climate and cultivation pattern. The area is dotted with natural and man-made wetlands ranging from large/medium size dams to small village tanks, including the canal system originating from Kota barrage. These were situated at (75°C 52' E, 25° 10' N) and details are in Table 2. The study was conducted for 36 months starting from July 1989, undertaking over 200 field trips to selected wetlands atleast once every month. All these wetlands were covered twice or more during the peak migratory season i.e. November to March. On each visit all the birds were counted specieswise with as much accuracy as possible.

Table 1 gives the waterbirds and wetland dependent bird species recorded during the study period. The record of water depths and vegetation growing in the wetlands was kept for the study period. The site details are provided in Table 2. Control graph of monthly population fluctuation has been presented in Fig.1 for 17 important waterfowl species. The annual average number of each species in the year 89-90 has been used as the control, for comparing the monthly averages of 90-91 and 91-92. Fig.2 shows the annual average number of most abundant waterfowl species on each of the wetlands. It shows why certain wetlands are preferred by certain waterbirds.

Ninety three waterbird species and 7 wetland dependent bird species were recorded during the three year period, from the study area. Forty three species of waterbirds are resident whereas 56 are migrant or locally migratory.

In all, 13 types of migratory ducks were recorded, out of which bulk of the population belonged to 6 species i.e. Pintail, *Anas auta*, Common Teal, *A.crecca*, Common Pochard, *Aythea ferina*, Tufted Pochard, *A.fuligula*, Shoveller, *Anas clypeata* and Brahminy Duck, *Tadorna ferruginea*. Comb duck, *Sarkidiornis melanotos* and Lesser Whistling Teal, *Dendrocygna javanica* were seen in large congregation in the months of January-February. Cotton Teal, *Nettapus coromandelinus* and Spotbilled Duck, *Anas poecilorhyncha* have a preference for shallow, vegetation filled wetlands, where they were seen in small flocks of 5-50 birds. A flock of Greylag Geese, *Anser anser* comprising of 17 to 56 individuals wintered at Abheda tank every year. Barheaded Geese, *Anser indicus* is more widely distributed.

Greatcrested Grebe, *Podiceps cristatus* was found on deeper waterbodies like, Alniya dam in almost constant number (Approx. 70 every year). They arrived early and left early (October to January) in the migratory season. Little Grebe, *P.ruficollis* have no specific preference and was found on all waterbodies in small number throughout the year.

All the three types of Cormorants, *Phalacrocorax* spp. were found in and around Kota but only Small Cormorants, *P.niger* were residents while the other two were locally migratory depending upon the water conditions.

Among the storks, White Stork, *Ciconia ciconia* was rarest with only one sighting. Black Stork, *Ciconia nigra* and Blacknecked Stork, *Ephippiorhynchus asiaticus* have also been occasionally seen during winters. Greater Flamingo, *Phoenicopterus roseus* were seen on Alniya every summer.

Two types of migratory cranes, Common Cranes, *Grus grus* and Demoiselle Crane, *Anthropoids virgo* (occasional autumn passage migrant) have been recorded from Kota. Sarus Crane, *Grus antigone* was frequently sighted on the wetlands and cultivated fields on the margins of the city. They breed in the reed marshes close to the city. Coot, *Fulica atra* is the most abundant waterbird (upto 6000) at Ummedganj, Alniya and Abheda.

A variety of waders and plovers, resident as well as migratory were recorded from the study area.

Among the waders, Ruff, *Philomachus pugnas* was most abundant in the area because of their preference for cultivated fields along with water-logged areas close to the wetlands. The noteworthy plovers and waders for their rarity were Golden Plover, *Pluvialis fulva*, Lapwing, *Vanellus vanellus*, Spurwinged Plover, *V.spinosus* and Avocet, *Recurvirostra avocetta*. The waders breeding successfully on the wetlands of Kota were Blackwinged

Stilt, *Himantopus himantopus*, Great Stone Plover, *Esacus magnirostris*, Redwattled Lapwing, *Vanellus indicus*, and Little Ringed Plover, *Charadrius dubius*.

Indian Skimmer, *Rynchops albicollis* is a rare summer visitor seen on the muddy islands of Alniya dam. Three types of raptors and 4 types of kingfishers, which are considered wetland dependent birds, have been recorded.

Wetland Habitat Preference

Greatcrested Grebe, *P. cristatus* have a preference for deep, open waterbodies and thus were seen only on Alniya dam. White Pelican, *Pelecanus onocrotalus* and Dalmatian Pelecan, *P.crispus* were also seen on open waters of Alniya and Ranpur. These species do not prefer the waterbodies with lots of floating vegetation as that may hinder their diving and feeding (Grebes) or netting the shoals of fishes (Pelecans). Large Cormorant and Shag were found on deep waterbodies while Small Cormorant were present on all wetlands as they can feed even in shallow water. Herons and Egrets were distributed on all wetlands, except that bitterns and Pond Heron preferred waterbodies with cover. Little Egret, *Egretta garzetta* and Cattle Egret, *Bubulcus ibis* have a preference for shall lower parts or even dry banks and agricultural fields. Storks do not show any specific preference for any wetland and depending on their choice of food, can be found on all waterbodies as well as irrigated fields (particularly Whitenecked Stork). A clear niche selection was observed in 3 types of Ibises. Glossy Ibis, *Plegadis falcinellus* fed in 18 to 24 inches deep water, White Ibis, *Threshkiornis melanocephalus* in shallow banks while Black Ibis, *Pseudibis papillosa* on dry ground near the water's margin or agricultural fields.

Diving ducks were invariably present on deep, open waterbodies like Alniya dam, Ranpur tank and Ummedganj Canal area and dabbling ducks showed a preference for the waterbodies where vegetation cover, grasses and weeds are present. On open waterbodies they were restricted to shallow banks. Among the resident ducks, Comb Ducks showed a preference for water-logged grassfields, Spotbilled Duck for open shallow waterbodies and Cotton Teal for weed-covered shallow waters.

Common Coot, *Fulica atra* was found in great abundance and other floating vegetable matter. The Waders congregated in good numbers (flocks of 100-1000 individuals) at the time of spring migration on the shallower waterbodies and on city nullahs with large drying margins where stilts, sandpipers, Redshanks, Godwit and Curlew assemble in large numbers. Otherwise smaller numbers were present on all waterbodies and water-logged fields throughout winter and around the city.

Redwattled Lapwing, *Vanellus indicus* and Blackwinged Stilt, *Himantopus himantopus* were present on all city nullahs and in the vicinity of the wetlands. Golden Plover, *Pluvialis fulva* and Spurwinged Plover, *Vanellus spinosus* have preference for the shores of Alniya dam. River Terns, *Sterna aurantia* were found in large numbers at Alniya and Ranpur whereas Whiskered Tern ,*Chlidonias hybrida* were commoner at Abheda and Ummedganj.

Twenty one resident waterbirds breed in and around Kota Table 1).

This is the first population study of waterbirds of Kota and any comparable data from the same geographical region is Karera Bustard Sanctuary in Madhya Pradesh (Rahmani, 1991). Among the migratory ducks, large congregations of Pintail, *Anas acuta*, Common Teal *A.crecca*, Common Pochard, *Aythea ferina* and Tufted Pochard , *Aythea fuligula* arrived on the wetlands of Kota. Tufted Pochard and Common Pochard were the first to arrive in late September and leave by January end. Common Teal, Pintail and Shoveler arrived in mid-October and remained till mid-April. The peak numbers of *Anas* sp. were seen during December to February while *Aythea* sp. peaked earlier by mid-November. The number of shoveler has gone down in the last two years for no apparent reason. The Garganey, *A.querquedula* were passage migrants during fall and spring return migration.

The Redcrested Pochard,, *Netta rufina* and Wigeon, *Anas penelope* were irregular visitors. Pigeon arrived in smaller number (50). According to Ali and Ripley, Gadwal (*Anas strepera*) is the commonest duck of central India but barring few exceptions (Alniya and Abheda, 1990) this has seldom been sighted. Same is true for Mallard, *Anas platyrhynchus*, which was seen at Alniya in 1991. The average population of resident ducks is low (5-50) and static. The number of Spotbilled Duck had risen in the summer of 1991 because smaller waterbodies in remote areas were dry due to poor monsoon in 1991, and perennial waterbodies like Abheda and Ummedbanj became the refuge for all resident ducks. The average population of waterbirds like Egrets, Jacanas and resident waders remained static excepting Blackwinged Stilt which congregated in larger numbers on the waterbodies in summer for breeding. The absence of breeding sites (trees) near the wetlands is a deterrent for all tree nesting waterbirds like storks, Spoonbills, Larger Egret and Grey Heron, Night Heron, Cattle Egret and Little Egret. The ground nesting species are relatively common in summer and pre-monsoon months showing an upswing in their numbers.

River Tern ,*Sterna aurantia* the commonest tern showed constant average population, with an increase during summer, when they congregate at Alniya and Ummedganj (dry canal bed) to breed. Greater Flamingo ,*Phoenicopterus roseus* arrived in flocks of upto 100 individuals during summer months at Alniya and left with the arrival of monsoon. The White Pelican, *Pelecanus onocrotalus* arrived from mid to late winter on larger waterbodies like Alniya and Ranpur and continue to be in the area till mid May.

Suggestions

The perennial wetlands are of greater importance for resident waterbirds. These are numerically getting depleted; and hence, must be conserved.

Creation of nesting sites for tree-nesting waterbirds is recommended. Tree cover in the catchment of the wetland will tackle the problem of siltation and water recharge.

Exploitation of Typha reeds must be regularised so as to reduce the habitat loss of certain resident waterbirds.

Drainage of smaller wetlands for illegal housing or cultivation must be stopped.

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Table 1 : Waterfowls and Wetland dependent Birds of Kota

1 *Grebe, *Podiceps ruficollis*
2 Great Crested Grebe, *P. cristatus*
3 Great White Pelican, *Pelecanus onocrotalus*
4 Dalmatian Pelican, *P. crispus*
5 Great Cormorant, Phalacrocorax carbo
6 Indian Shag, P. fuscicollis
7 *Little Cormorant, P.niger
8 Oriental Darter, Anhinga melanogaster
9 Cinnamon Bittern, *I. cinnamomeus*
10 *Blackcrowned Night Heron, *Nycticorax nycticorax*
11 *Pond Heron ,*Ardeola grayii*
12 *Egret , Bubulcus ibis
13 Striated (Little Green) Heron , *Butorides striatus*
14 *Little Egret, *Egretta garzetta*
15 Intermediate (Smaller) Egret, E.intermedia
16 *Egret , E. alba
17 Purple Heron, Ardea prpurea
18 Grey Heron ,A. cinerea
19 Grey Heron, Ardea purpurea
20 Painted Stork ,Mycteria leucocephala
21 Asian Openbill, Anastomus oscitanius
22 Black Stork ,Ciconia nigra
23 Blackynecked (White-necked) Stork ,C.episcopus
24 White Stork ,C.ciconia
24 Blacknecked Stork ,*Ephippiorhynchus asiaticus*
25 Blackheaded (White) Ibis ,*Threskiornis aethiopica*
26 Black Ibis , *Pseudibis papillosa*
27 Glossy Ibis , *Plegadis falcinellus*
28 White Spoonbill , *Platalea leucorodia*
29 Greater Flamingo , *Phoenicopterus roseus*
30 Lesser Whistling Duck (Lesser Tree Duck) , *Dendro cygna javanica*
31 Greying Goose, Anser anser
32 Barheaded Goose ,A.indicus
33 Rubby Shelduck ,Tadorna ferruginea
34 Comb Duck ,Sarkidiornis melanotos
35 *Indian Cotton Teal ,Nettapus coromandelianus
36 Eurasian Wigeon, Anas penelope
37 Gadwall , A.strepera
38 Common (Green-winged) Teal , A.crecca
39 Mallard , A.platyrhynchos
40 *Spotbilled Duck , A.poecilorhyncha
41 Northern Pintail , A.acuta
42 Garganey , A.querquedula
43 Northern Shoveir , A.clypeata
44 Redcrested Pochard , Netta rufina
45 Common Pochard Aythya ferina
46 Ferruginous Duck , A.nyroca
47 Tufted Duck , A.fuligula
48 Common Crane, Grus grus
49 *Crane , G.antigone
50 Demoiselle Crane, Anthropoides virgo
51 Slatybreasted Rail, Rallus striatus
52 *Whitebreasted Waterhen , A.phoenicurus
53 *Moorhen , Gallinula chloropus
54 *Purple Swamphen , Porphyrio porphyrio
55 Common Coot, Fulica atra
56 *Pheasant-tailed Jacana, Hydrophasianus chirurgus
57 *Bronzewinged Jacana , Metopidius indicus
58 *Painted Snipe, Rostratula benghalensis
59 *Stilt , Himantopus himantopus
60 Avocet, Recurvirostra avosetta
61 *Great Stone Plover , Esacus recurbirostris
62 Little Pratincole, Glareola lactea
63 Northern Lapwing,. Vanellus vanellus
64 Yellowwattled Lapwing , V.malabaricus
65 White-tailed Plover , V.leucurus
66 Spurwinged Plover , V.spinosus
67 Redwattled Lapwing , V.indicus
68 Golden Plover, Pluviali apricaria
69 Grey Plover, P.squatarola
70 *Little Ringed Plover , Charadrius dubius
71 Kentish Plover ,C.alexandrinus
72 Blacktailed Godwit , Limosa limosa
73 Bartailed Godwit, L.lapponica
74 Curlew, Numenius arquata
75 Spotted Redshank, Tringa erythropus
76 Redshank, T.totanus
77 Marsh Sandpiper, T.satagnatilis
78 Greenshank , T.nebularia
79 Green Sandpiper, T.orchropus
80 Wood Sandpiper , T.glareola
81 Common Sandpiper , Actitis hypoleucos
82 Common Snipe , Gallinago gallinago

83 Little Stint , Calidris minuts
84 Temminck's Stint, C.temminckii
85 Dunlin, C.alphina
86 Ruff , Philomachus pugnas
87 Great Blackheaded , Gull Larus ichthyaetus
88 Brownheaded Gull, L.brunnocehalus
89 Blackheaded Gull , L.ridibundus
90 Whiskered Tern, Childonias hybrida
91 Indian River Tern , Sterna aurantia
92 Blackbellied Tern , S.melanogaster
93 Indian Skimmer , Flynchops albicollis

Wet Land Dependent Water Bird Species

94 Osprey, Pandion haliatus
95 Marsh Harrier, Circus aeruginosus
96 Imperial Eagle, Aquila heliaca
97 Lesser Pied Kingfisher, Ceryle rudis
98 Common Kingfisher, *Alcedo atthis*
99 Storkbilled Kingfisher, *Pelargopsis capensis*
100 Whitebreasted Kingfisher, *Halcyon smyrnensis*
*Breeding waterbirds of Kota

Table 2. Details of the wetlands of Kota

Name of the wetland	Type of the wetland	Distance from the Kota city	Catchment	Submergence (Hectare)	Depth max/min (metres)	Vegetation
Abheda tank	Man man tank	6 kms	Not known	20*	4/1.5	Emergent & floating, grass, sedges
Alniya dam	Medium size dam	23 kms	201.35 km^{2+}	1210+	10/1	Floating algal strands, weeds
Lakhawa tank	Village tank	11 kms	2.35 km^{2+}	80+	5/Dry	Floating algal strands, weeds
Ranpur tank	Village tank	17 kms	4 km^{2+}	130+	2/Dry	Submerged/floating algae, weeds
Ummedganj	Canal/seepage pools	8 kms	No known	15*	2.5/1 (Pools) 3/Dry (Canal)	Uprooted floating emergent & submerged

* Approximate
\+ Official record

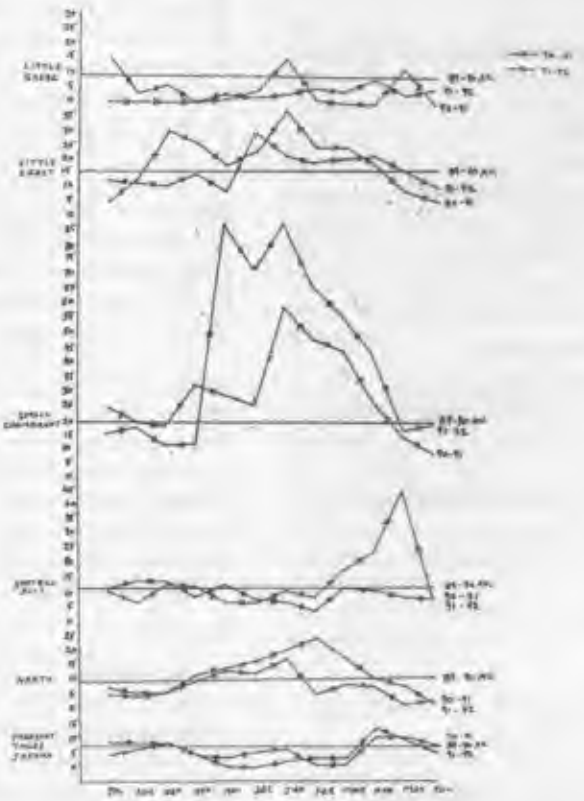
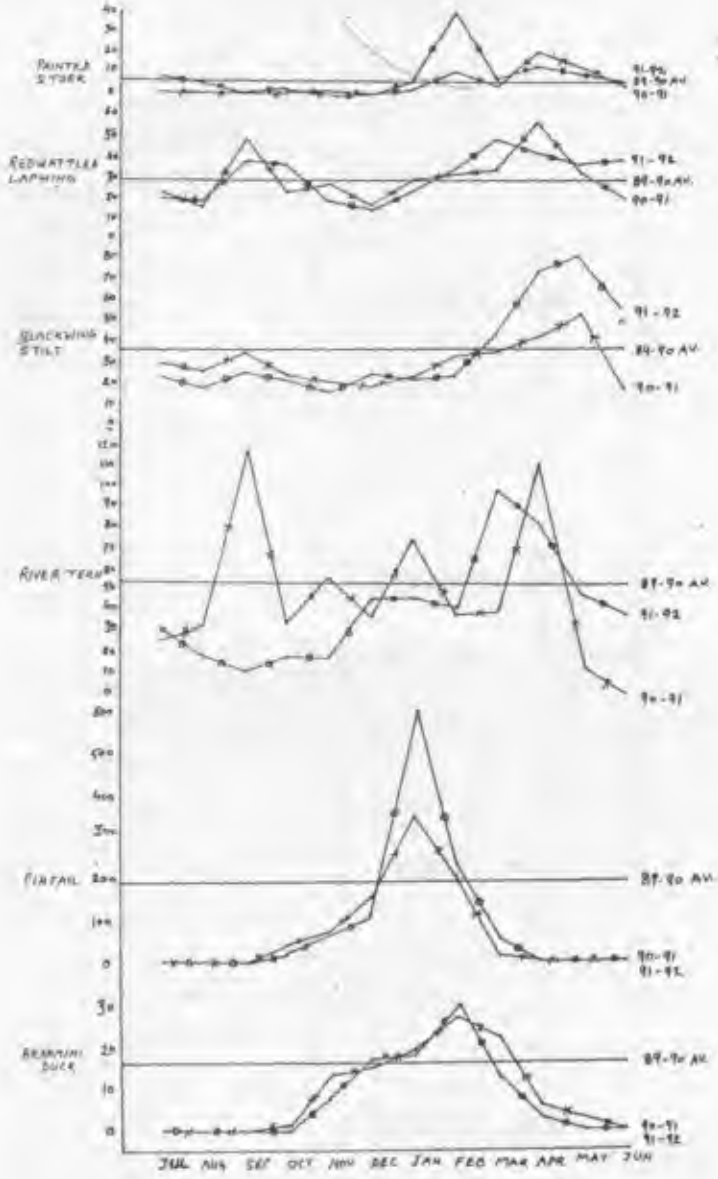


Fig. 1 : Control chart for population trend of important waterbirds at Kota.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REDWATTLED LAPWING
BLACKWING STILT
RIVER TERN
FINFAIL
BRAHMINI DUCK
JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN

Fig. 1

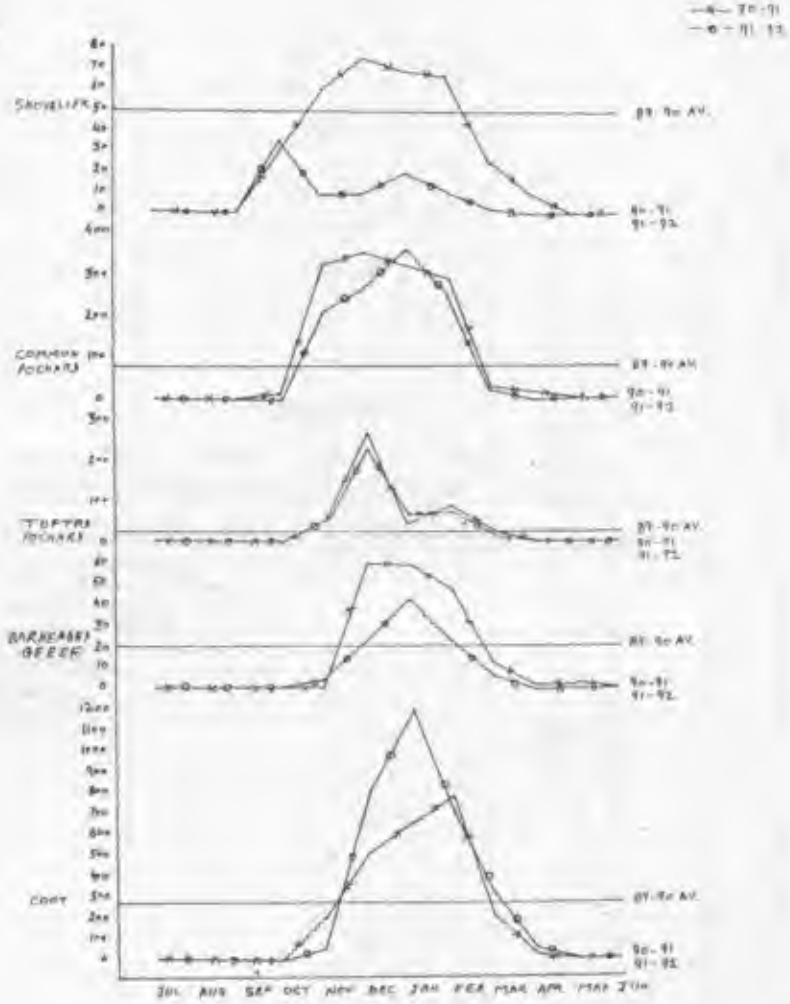
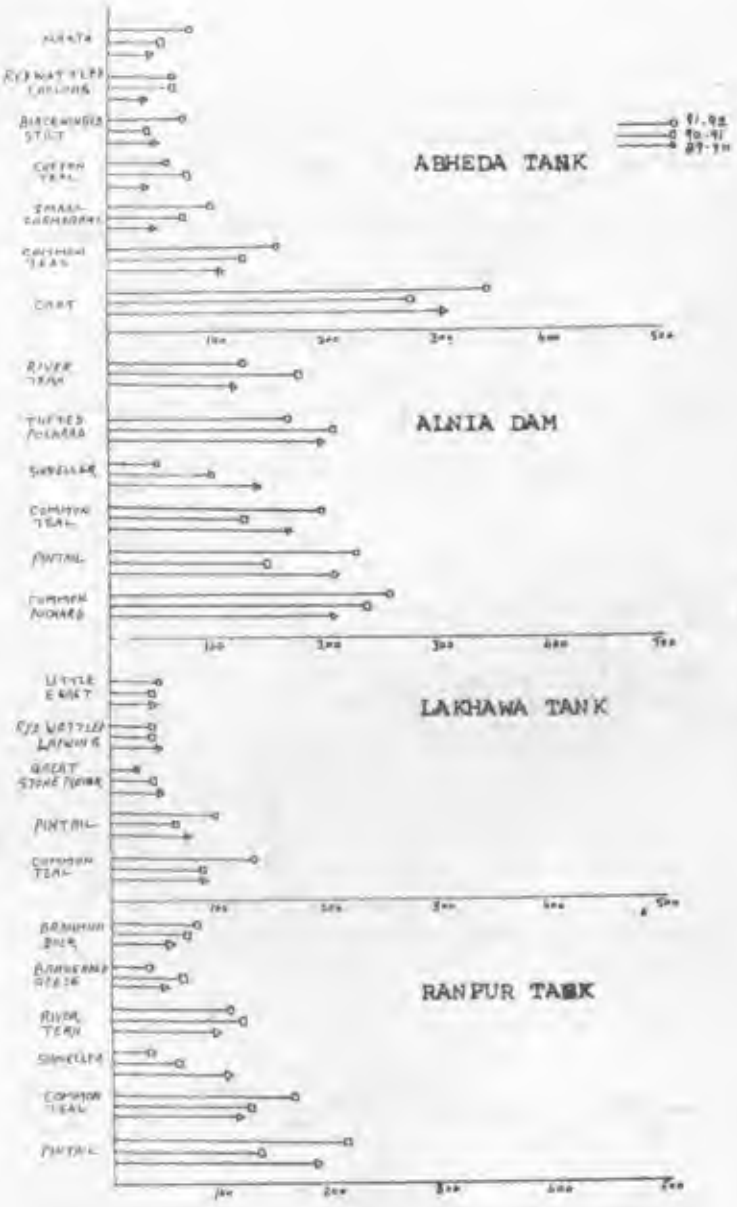

SPOONBILL
COMMON POCHARD
TUFTED POCHARD
BARHEADED GEESE
COOT
JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN

Fig. 1



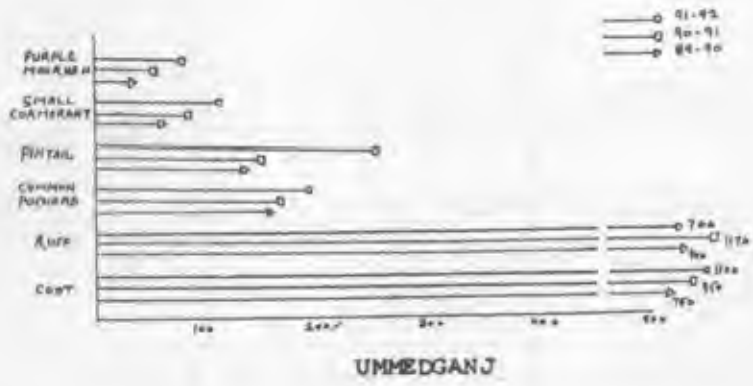


Fig. 2 : Habitat preference of Waterbirds at Kota.

Fig. 2

Island Size and Forest Bird Distributions in the Andaman Islands

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A survey was conducted of forest birds in 28 islands of different sizes in the South Middle and Little Andamans. Vagile genera and species were excluded from the analyses. Thirtynine species of forest birds were recorded. Island size was important in determining the number of species. Large islands (90sq km)had all 39 species whereas Islands less than 1sq. km had only 27 of the 39 species. Raptors were the most sensitive to island size. Islands smaller than 0.1 Sq km had only 18 species, and 21 species were not recorded on small islands at all. This showed that for conservation of forest bird diversity, only islands greater than 1 sq km are important and for the raptors this area should be greater than 10 sq km.

Winter Waterfowl Population at Myani Bird Reserve

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A freshwater reservoir near Myani town in the district Satara, Maharashtra is a regular site for winter migratory waterfowl. The site is a typical wetland habitat. Bird counts have been done at the site regularly in January every year since 1990. The counts were carried out in mornings on foot using a pair of 8 x 40 binoculars. The data indicated marked fluctuations in total number of birds, while there was a slight change in the total species spotted. The results indicated that more studies in relation to light, climate, biological and physical factors have to be carried out. Possible reasons for population fluctuation of waterfowl at the site have to be identified before conservation measures can be suggested.

Nesting Mortality of Birds in an Open Woodland and Scrubland Near Bangalore

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Introduction

The Indian tropical forests are disappearing at an alarming rate. The problems faced in commercial timber, rapid extension of rail and road networks, extension of agriculture into forest areas, growth and demands of mega cities and towns, Hydroelectric projects are exerting considerable pressure on the bird communities.

Ecologists need to know about the breeding rates and nest mortality of birds so that they understand how effectively the population survive under various conditions.

Of particular importance in the context of open woodland and scrubland, are nesting studies to identify species whose breeding success are threatened and elucidate conservation measures Therefore,1987 a study in an open woodland and scrubland was initiated.

Material and Methods

An open woodland area located 50 km south west of Bangalore City (77° 16' E, 13° 45' E) was the major study area and another piece of scrub about 8 km west of the open woodland was the second study area. The main study area was made-up of secondary forest habitat with a open woodland, wedged between a stretch of over 2 kms along a seasonal river bed and agricultural farms characterised by coconut, mulberry, areca, mango, banana, sugarcane and vegetable gardens. The second study area is situated about 8 km west of the main study area where most species of ground nesters were studied in the scrub land of 5 sq km.

We recorded the Nesting data of Birds in detail for 5 years from Jan 1988 to Dec 1992. Peak breeding seasons on all birds were also recorded. Nests were located by discretly watching the movement of the birds from a distance. Birds at nest were observed without disturbance using a 8 x 40 binoculars from blinds erected early in the morning or from a parked vehicle. Photographs of most bird species studied were also taken using a 300 mm telephoto lens to analyse the types of nest, clutch, size, egg colour and pattern.

Regular field notes on individual, seasonal and ecological differences in nest structure, site preference by different species were maintained. The average number of days spent by the parents in nest construction, egg laying, duration of incubation, care of nestlings, and the length of nesting period for each species studied, were also recorded. The number of broods, the state at which the nest failed, the interval between the destruction of the nest and renesting were recorded.

As typical of such studies, we could not always witness the loss of an egg or nestling; hence we relied on circumstantial evidence to interpret our conclusion. Normally a nest seen undisturbed with eggs or healthy chicks on a particular day but found empty, a day or two later, were attributed to predation.

For most avian species, it is almost impossible to trail fledgings once they leave the nest. For this reason studies of avian reproduction generally concentrate on survival rates and nesting success only through the fledging of young (Ricklefs,1969). We have presented our observations upto fledging of young from the nest.

The average life span of all nests attempted each year and progressive destruction of active nests by predators or other factors at any stage of the nesting for five separate years were recorded for analysing the nest survival data of individual species. Vegetation type and nesting data were recorded by walking and where necessary additional spots within the study area were frequented. The natural history and nesting data have come from our own field observations.

Results and Discussion

A total of 394 nests belonging to 40 species of birds were recorded during the study period. However, results of only 201 nests are included for analysis of in this paper. Out of 201 nests, only 50 reported success and the remaining 151 nests failed. Thus 75.13% of all nesting attempts failed. We again separated the mortality at egg stage from the mortality at chick stage.

Predation

Predation accounted for 66 % nest losses, at both egg and chick stages. 42% at the egg stage and 24% at nestling stage that are lost are lost to predators.The most frequent cause of eggs and nestling mortality is predation of complete clutches and complete broods. Therefore the rate of an egg or nestling is not statistically independent of its nest-mates. The second most common cause of nest mortality was human intervention (15%)(Table 6). Having identified predation as major cause of the egg and nestling mortality, the seasonal distribution of predation was examined.

Rainfall

The reasons for wide annual fluctuations in predation rate are unclear at present. One interesting environmental factor is the amount of rainfall received and the timing of the rainfall. For example in the case of White spotted Fantail Flycatcher, which has a fairly synchronised breeding season; the nest failure was less after the pre-monsoon showers (Sridhar *et al.*, 1989), but was relatively high before the pre-monsoon showers.

Rainfall can influence nest predation by (1) the density or activity of nest predators, (2) the availability of alternate food source for the predators, (3) the time budgets and nest vigilance of parents, and (4) vegetation cover surrounding the nests (Woolfenden, 1974).

Synchronous nesting

Horn (1968) felt that if the birds produce their young during a short interval of time, predator appetites might be saturated quickly, as a conveyance, individuals might attain a higher probability of keeping their offspring alive than if nesting asynchronously. If there were sufficient resources for all predators at a short period than the individuals might have a higher success rate. The success rate will be influenced by predator density.

At least 6% of the nest predation is directly attributed to predatory birds (bird of Prey; Crow; Coucal; Malkoha). We feel that few other nest failures were due to the activity of these predators. In several instances, the confrontation and mobbing of these predators by the nesting birds was observed. Several behavioral studies have suggested that mobbing responses may be provoked by the predator in order to attract or obtain information about the prey and its nest(Smith 1969,Smith 1984, Mclean *et al.*, 1987). Since the density of predators were higher than normal as noticed by the frequent mobbing of predators by the nesting birds, nesting mortality was also relatively higher in the study area.

Grouping births

The reasons for fluctuations in predation rate are unclear at present. One interesting phenomenon was 'grouping births' in time as a response to predation.

Most of the birds studied had a short synchronised breeding season. This relatively synchronised breeding season extends from April to August, with June and July as peak nesting season. Individuals may be able to reduce per capita predation on dependent offspring by Grouping Births in time. If the birds produce their nestling during a short time interval, predator appetites might be satiated quickly, as a consequence, individuals might attain higher probability of keeping their offspring alive than if nesting asynchronously (Pulliman & Caraco 1978). For example, the Indian Robin and the Yellow wattled Lapwing have a short synchronous breeding season and almost all the nests were found during April. The two species exhibited considerable breeding success (Table 2 and 5).

In contrast the Whiteheaded Babbler had asynchronous nesting and the breeding season extended from March to September without any peak nesting period. This species exhibited utter nesting failure, probably due to this phenomenon. Similarly the Purple rumped Sunbird exhibited asynchronous nesting cycle extending from February to November with disastrous nesting results. The nesting season tapers off by September, one possibility is the necessity of completing postnuptial molt and the other being competition for food resources from winter migrants.

Variability in reproductive success could proximately arise from any combination of variation in four principle factors (1) clutch size (2) loss of eggs or nestling through predation (3) human interference which in turn vary with annual differences in environmental variables such as humidity, food availability and vegetation cover (Woolfenden, 1974). However, the overriding cause of annual variation in reproductive success apparently lies in variable predation rates, as observed in the study area.

It is possible that some species were exposed to pesticides while feeding in cultivated tracks, surrounding the study areas (Beehler,*et al* 1987). In natural areas, such instability may be caused by drought or through predation, but in our study area, breeding results were good in certain years only. We can analyse the effect of disturbances in past by comparing similar data from populations with that from other undisturbed areas.

Peak nesting season

The overall chronology is summarised in Table 7 which emphasised that all birds actively nest during June-July. For reasons incompletely understood, the nest cycle of most birds are timed to coincide with south west monsoon. The Table shows that maximum number of nests were observed in June-July. However the 'potential nest life span' varied between 32 days to 48 days for different species from the day nest construction started to the day the nestlings left the nest in case of altricial birds and 28 to 32 days in case of precocial birds in the study area. The table reveals that the ratio of failure due to predation was lower from June onwards and the higher in May and June; maximum nests were found in June followed by May and July. This illustrates that the peak breeding season is coincided with the onset of south west monsoon.

Nest Type and Nest Site Quality

Birds were classified as per the type of their nest (Tables 1 to 5). in order to get an inkling on the different types of nesting and individuals differences in competitive ability to locate the nest at a safer place. It was found that the proportion of success increased with the ability of the species to effectively conceal its nest or camouflage the eggs in ground nesters. The nesting type influences a species reproductive success through nest conspiciousness or crypticity and quality of nest site (Alatalo *et al* 1986). For some birds crypticity and an often solitary existence may be a response to predation (Tinbergen *et al.*, 1967). Our data reveals that the open cup shaped nests and partly hidden nests accounted higher mortality rate than hidden cavity nesters and ground nesters of certain species, that could effectively conceal their eggs on the ground.

Cost of living in Groups

The Whiteheaded Babblers live in cooperative groups. Grouping might exact a cost in terms of predation. Groups

might be more conspicuous than solitary to a predator searching at a distance depending on the predator's sensory mode and activity (Vine, 1973,) for some prey crypticity and open solitary existence may be a response to predation (Tinbergen *et al.*, 1967; Pulmanm and Mills, 1977). To investigate this, we analysed the nesting data of the White headed babbler,and found that the reasons for the utter failure of nesting in White headed babbler is perhaps due to the above phenomenon.

In addition, intra group nest destruction is known to occur in complex group and groups containing several males as in Arabian Babblers (Zahavi 1974). Since Whiteheaded Babbler exhibits similar social behaviour and lives in complex groups (Gaston and Perrins,1974), it is possible that the low success rate in the study area for this species is due to destruction of nests by babblers themselves, than from other predators. Zahavi strongly feels that some losses are attributable to inter group conflicts rather than predation.

Quality of Nest Site

Since nest predation is the single most important factor influencing breeding success, under natural conditions, the effect of high quality nest site is likely to compensate for reduction in quality of other factors. For example, in Pied Flycatcher, the single most important criterion may be nest site quality (Alatalo et al 1986). Nest predation was the farmost important factor reducing breeding success in the Pied Flycatchers (Alatalo and lundberg 1990). Based on the nest site properties, they were able to predict with 79% accuracy the nest suffering from predation or being successful. The nest cavity as protection against predation might be especially important for the Pied Flycatcher where an incubating female runs the risk of being taken by a predator herself (Haartman 1971). Atleast in 3 instances, the breeding parent was killed by a bird of prey in the study area (Table 6). But other factors of nest site quality might be important too. There are several cues for the breeding pair of which nest site quality is most important (Termin *et al.*,1989)

Quality of Territory

We also considered the question whether the territory quality and size in the study area influenced reproductive success. Example of benefits (other than food) of an increase in territory size in Great Tit helped in decreased predation by Weasels and spacing out reduces predation and nestlings (Krebs, 1971). In our main study area, problems are stemmed from human perturbations, such as extension of agriculture in to forest areas, cattle gracing and tree felling. This has resulted in decreased diversity of the flora. Because of this seemingly edge effect, we feel that the nesting mortality was higher in our study area. Analysing 24 studies involving 7788 nests, (Nice 1957) reported that the success rate of open nests of altricial birds ranged from 38 to 77% (average 49%). But in our study area the success rate was around 24% only. One of the reasons being the decreased diversity of flora, that has reduced the quality of the territory of the breeding birds. For instance, We noticed two pairs of White-eyes nesting simultaneously just 15 feet apart. We observed that the male white eyes of these two nests indulged in day long all-out territorial battles while the females were left to attend to the nest all by themselves. In normal circumstances, We have observed the male white eye allofeeding the female at nest during the first days of hatching.

Since the nestlings are unable to thermoregulate for four to five days after hatching, the females had difficulties in raising the young on their own, due to the reduced assistance from the male counterparts. We feel that long distance between two nests of the same species could decrease the aggressive interaction between the two males. Interestingly both the nests failed; one at egg stage and the other at nestling stage! This demonstrates that quality and size of the territory can influence reproductive success (Andersson and Wickland, 1987).

Maintenance of diversity contributes to forest health by providing more varied habitats, quality nesting sites and food resources for the wild birds. All these factors disscussed in this paper, independently or cumulatively influenced the nesting mortality of the birds in the study area.

Data from the nesting birds, has increased our understanding of how competition for high quality nest sites and nest predation influence the relative breeding success of the birds.

Given the tremendous awareness and concern for environmental problems, and fragile nature of our avifauna, current emphasis on bird conservation should be extended to study of breeding biology of birds in a given area, to enable researchers to make qualitative predictions in future.

Clearly such studies are of great importance in the management and conservation of birdlife on earth.

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Table 1: Open cup (attached statint) nests

Sl. No.	Bird species	% of success
1.	Iora	0
2.	Red vented Bulbul	7.14
3.	White eye	12.5
4.	Yellow eyed Babbler	14.2
5.	Blackheaded Cuckoo Shrike	20
6.	White Browed Fantail Flycatcher	20.8
7.	Red Whiskered Bulbul	27
8.	White Browed Bulbul	50
	Avergage	20.75

Table 2: Hidden cavity nest

Sl. No.	Bird species	% of success
1.	Pied Bush Chat	0
2.	Magpie Robin	20
3.	Tickell's Blue Flycatcher	42
4.	Grey Tit	50
5.	Indian Robin	66
	Average	35

Table 3 : Open Nests (Partly Hidden)

Sl. No.	Bird species	% of success
1.	White headed Babbler	0
2.	Black Drongo	0
3.	Bay Backed Shrike	22
4.	Tree Pie	50
5.	Golden Fronted Chloropsis	50
	Average	21.71

Table 4: Hiltden Pendulous nests (Warblers)

Sl. No.	Bird species	% of success
1.	Southern Ashy Grey Warbler	0
2.	Tailor Bird	10
3.	Indian Wren Warbler	16.6
4.	Ashy Wren Warbler	28.5
5.	Streaked Fantail Warbler	50
	Average	19.2

Table 4A: Open pendulous nests (Sunbirds)

Sl. No.	Bird species	% of success
1.	Tickell's Flower Pecker	0
2.	Purpled Rumped Sunbird	18
3.	Purple Sunbird	25
	Average	18.7

Table 5: Ground nests (Altricial)

Sl. No.	Bird species	% of success
1.	Redwinged Bush Lark	25
2.	Indian Pipit	33.3
3.	Rofous tailed Finch Lark	50
	Average	285

Table 5A: Ground nests (Precocalal)

Sl. No.	Bird species	% of success
1.	Red Wattled Lapwing	20
2.	Yellow Wattled Lapwing	40
3.	Jungle Bush Quail	66
4.	Grey Partridge	50
	Average	42

Table 6 : Failure Analysis

Sl. No.	Reasons for failure	No. of nests failed
1.	Abandoned at construction stage	14
2.	Cut by firewood collector / grass cutter	12
3.	Vandalism	5
4.	Trampled by sheep/cattle	3
5.	Predated by crow/coucal/Mal koha	7
6.	Predation of eggs during incubation by an unknown predator	60
7.	Predation of chicks by unknown predator	37
8.	Breeding parent killed by a bird of prey	3
9.	Other reasons	
	(a) Flash floods	2
	(b) Wind dislodges branch with nest	3
	(c) Cat eats chicks	1
	(d) Ploughing of fields	2
	(e) Snake predates chicks	2
	Total	151

Table 7 : Failure rate by moving average method

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total nests		9	19	29	36	44	39	18	5	1	1	
Number of nests failed due to predation		6	9	15	23	19	16	9	2			
Failure rate %		66	47	51	63	43	41	50	40			

Bird Attracting Wild Flora of Sidderbetta, Tumkur District, Karnataka State

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Introduction

The subject of bird-plant association has received very little attention in India. Recently Subramanya and Radhamani (1993) reviewed the Indian literature on bird and bat pollination. According to them, a total of 58 bird species from 16 different families and 4 orders have been observed pollinating 93 species of flowering plants belonging to 34 families and 20 orders. Malvaceae, Fabaceae, Myrtaceae, Bignoniaceae and Verbenaceae are reported to produce bird flowers and are the most ornithophilous plants of India. Certain plant species like *Bombax ceiba*, *B. incignae* and *Erythrina variegata* and E.sritota are visited by 50 different species for nectar. Mistletoes (Loranthaceae) are probably one of the well studied groups of ornithophilus plants. Of the 93 species of plants pollinated by birds over 80% of them are frequented by more than one bird species (Subramanya and Radhamani, 1993) indicating the generalised relationship between birds and plants. They also stated that though nectar is a good source of energy it is a poor supplier of protein and hence they probably derive their protein requirement by consuming animal matter.

In this paper, we have attempted to provide the dependence of birds for nectar and fruits as a possible source of carbohydrates, fats and proteins with a particular reference to the flora of Sidderbetta in Tumkur district.

Material and Methods

Extensive floristic surveys were conducted in Sidderbetta from 1985 to 1992 to collect plants during all seasons and observations were recorded on the phenological characters. The list of bird attracting plants were confirmed from the earlier reports of Ali (1932) and Subramanya and Radhamani (1993). More plants were added based on authors' observations.

Sidderbetta is the tallest hill in Tumkur District known for its medicinal plants (Bhaskar and Kushalappa, 1993). The average annual rainfall is about 750 mm with peak during July - October.

In order to study the distribution of bird attracting plants in relation to different habitats the hill was classified into four different habitats based on distinct altitudinal, edaphic and biotic factors. The altitude ranged from 750 meters at the foot of the hill to 1272 meters at the top of the hill. Shorea Grove (SG) consisted of a dense canopy mainly of evergreen tree *Shorea roxburghii*, sheltering a large number of undergrowth species. The foot hill (FH) was mostly scrub with *Anogeissus latifolia*, *Lagestromia parviflora*, *Terminalia paniculata*, interspersed among Lantana or often grassy patches wherever rocky strata existed. The slope and valley (SV) mostly consisted of *Gardenia latifolia*, *Vitex altissima*, *Sterculia urens*, *Grewia* spp., *Ficus* spp., interspersed with grassy patches. The hill top (HT) vegetation rarely consisted of trees such as *Memecylon umbellatum*, *Sterculia guttata* etc in patches but mostly rocky interspersed with grassy moist patches.

Results and Discussion

In the present study, 285 wild species of flowering plants from Sidderbetta are reported. These plants fall under 78 families of which Fabaceae is the most dominant with 43 species followed by Rubiaceae(17). Asteraceae (12), Euphorbiaceae(10), Acanthaceae (9) in order. Totally 51 plants in Sidderbetta are found to attract birds for nectar and twentyone for fruits and the remaining eleven species attract birds for both nectar and fruits.

Table 1 shows that most bird attracting plants are present on higher and middle levels of the forest canopy compared to the lower levels. In addition, most of these plants are perrenial in nature and are regularly available for the birds to feed on.

If we look into the distribution of the bird attracting plants in different habitats it is evident that slopes and valleys have the largest number of bird attracting plants (27) compared to other habitats. The number is least on the top of the hill i.e. HT (4) which may be due to the relatively poor distribution of plants on the top of the hill. Even on the foot of the hill the number is small, perhaps due to large scale deforestation and invasion of weeds. Although Shorea Grove (SG) represents a small area of about 100 acres, the number of bird attracting plants is large compared to the total area of the hill.

From these findings it is evident that the slopes and valleys have the largest number of plants that attract birds for fruits and fruit trees yielding nectar and also a higher number of plants that attract birds for nectar. The Shorea Grove had the highest number of bird attracting plants for nectar. These results indicate that bird - plant interaction is very high in the valleys, Shorea Grove, and it is moderate on the foot hills but is lowest on the top of the hill.

Prasad et. al. (1982) have reported 132 species of birds from Devrayanadurga State Forests in Tumkur district which lies in close proximity to Sidderbetta State Forests. 48 bird species (33%) of Devaryanadurga are dependent on plants for nectar or for fruits. 16 species are nectar feeders and 11 feed on fruits and the remaining 21 feed on both nectar and fruits. This study indicated the importance of this bird-plant interrelationship in a deciduous forest ecosystem which is very similar to Sidderbetta. Similar studies need to be undertaken in Sidderbetta to substantiate that this is an important habitat biologically that needs protection .

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Table 1 : Distribution of different species of bird attracting plants in four different habitats in Sidderbetta

PLANT FORM	FH	SG	SV	HT	TOTAL
TREES	5	6	14	1	26
SHRUBS	6	2	8	3	19
CLIMBERS	-	4	1	-	5
EPIPHYTES	-	-	3	1	4

(FH) FOOT HILL (SG) SHOREA GROVE (SV) SLOPES AND VALLEY (HT) HILL TOP

Table 2: Distribution of nectar and fruit yielding plants in the four habitats in Sidderbetta

HABITATS	FOR NECTAR	FOR FRUITS	FOR BOTH	TOTAL
FH	3	5	4	11
SG	10	1	1	12
SV	8	14	5	27
HT	1	3	1	5
	21	23	11	

Table 3 : Bird Attracting Flora of Sidderbetta

Sl no	Botanical name	Distribution	Plant form
A. Plants that attract Birds for Nectar			
1	Aristolochia indica	SG	CL
2	Bauhinia racemosa	SV	TR
3	Butea monosperma	FH	TR
4	Canavalia virosa	SG	CL
5	Calatropis gigantea	FH	SH
7	Celestrus paniculata	SG & SV	CL
8	Cochlorospermum religiosum	SV	TR
9	Firmiana colorata	SV	TR
10	Gloriosa superba	SG	CL
11	Helectris isora	SG & SV	CL
12	Kalanchoe pinnata	HT	SH
13	Legerstromia parviflora	SV	TR
14	Mitragyna parviflora	SG	TR
15	Pongamia pinnata	FH	TR
16	Pterocarpus marsupium	SG	TR
17	Schleichera oleosa	Sv	TR
18	Shorea roxburghii	SG	TR
19	Vitex altissimma	SG	TR
B. Plants that attract Birds for their fruits			
20	Bridelia retusa	SV	TR
21	Catunaregam spinosa	FH	SH
22	Cipadessa baccifera	FH	SH
23	Cordia wallichiana	SG & HT	SH
24	Diospyros melanoxylon	FH	TR
25	D. montana	SV	TR
26	Ficus amplissima	SV	TR
27	F. auriculata	SV	TR
28	F.benghalensis	SV	TR
29	F.microcarpa	SV & HT	TR
30	Gardenia latifolia	SV	TR
31	Gymnosporia wallichiana	SV	SH
32	Physalis minima	SV	SH
33	Phoenix humilis	SV	SH
34	Santalum album	FH	TR
35	Securinega leucopyros	FH	SH
36	Solanum nigrum	SV	SH
37	Syziphus cumini	SV	TR
38	Zyziphus mauritiana	SV	SH
39	Z.rugosa	HT	SH
40	Z.xylopyrus	SV	SH
C. Plants that attract birds for both Nectar and fruits			
41	Bombax ceiba	SV	TR
42	Capparis zeylanica	SV	SH
43	Canthium parviflora	FH	SH
44	Dendrophthoe falcata	SV	PA
45	Elytrathe parasitica	HT	PA
46	Gmelina arborea	SG	TR
47	Ixora arborea	FH	TR
48	Lantana camera	FH	SH
49	Madhuca indica	FH	TR
50	Viscum articulatum	SV	PA
51	V.ramosissimum	SV	PA

Avifaunal Survey of Forest Reserves in Mahadayi Valley, Western Ghat During April-May 1993

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Introduction

An extraordinary diversity of bird species still prevails in the hill forests of Western Ghats in Karnataka. But, only a few detailed published accounts about them are found. Birdwatchers, naturalists and surveyors in the past, notably J. Davidson, Salim Ali and W. Koels and others who carried out bird surveys in South Konkan, North Canara, Mysore, Goa and also neighborhood of Londa in Khanapur Taluk published bird lists concentrating more on taxonomy. Due to lack of proper scientific knowledge on river ecology and water management some pristine evergreen biotopes in Western Ghats were lost to power projects and mines in Karnataka. The present survey was aimed at determining the diversity of bird habitats and bird specialists of Mahadayi valley in Western Ghats and to publish records to assist with the conservation of important forests in the Valley. So far, no systematic study has been made of the Avifauna of the moist and evergreen forests of this valley. The paper deals with the survey of birds in relation to their habitats and their distribution in the valley. A checklist of birds recorded during the survey is furnished.

Material and Methods

The five main survey areas in the Valley, namely : 1) Chapoli, 2) Kabnali, 3) Gavali, 4) Krishnapura and 5) Telewadi are shown in Map III. The survey was carried out during early morning hours of April and May 1993. On roads negotiable with jeep, bird counts were taken at intervals of 1–2 km regularly. The total number of survey trips worked out to be at the rate of two trips for each forest reserve, that is 10, regular trips and 2 review trips amounting to 12 trips in all,

The total survey time in each of the five survey areas was as follows :

Areas of Chapoli – 17th & 18th April (2 days Jamboti camp)

Areas of Kabnali – 24th & 25th April (2 days Jamboti camp)

Areas of Gavali – 28th & 29th April (2 days Shiroli camp.)

Areas of Krishnapura – 5th & 6th May (2 days Shiroli camp)

Areas of Telewadi – 17th & 18th May (2 days Armode camp)

Review Trips – 26th & 27th May (2 days Anmode camp)

Birds were recorded along roads between 1) Khanapur and Jamboti (18 km), 2) Between Jamboti and Anmode (30 km) and between 3) Anmode and Londa-Gumji (40 km). Photographs of vegetation, flowers and fruits found in the valley along with birds in their natural surroundings wherever possible were taken. In situations where it was impossible to penetrate and find access to the bird it was identified from the call. Local people were consulted about the proposed power project in the valley. The manganese-mine pit area in Jamgaon was also visited and surveyed.

Results and Discussion

Distributional patterns

A total of 112 different species of birds belonging to 42 families in the 5 forest reserves of Mahadayi Valley were recorded. Families of birds which were found to be the most dominant in the area were *Pycnonotidae* (bulbuls); *Muscicapidae* (flycatchers); *Columbidae* (doves) all having 7 species each followed by *Turdidae* (thrushes) with 6 species and *Campephagidae* (cuckoo -shrikes); *Picidae* (woodpeckers); and *Timalidae* (babblers) with 5 species each; and *Sturnidae* (mynas); *Irenidae* (leafbirds); *Psittacidae* (parrots); *Cuculidae* (cuckoos) and *Bucerotidae* (hornbills) with 4 species each. Others such as *Dicaeidae* (flowerpeckers) and corridae (crows) were found with 3 species each. The remaining families have either 3, 2 or 1 species.

(A) *The Chapoli Forest Reserve*

This reserve with an altitude of 1995 feet msl. has an area of nearly 6,403.00 acres and includes villages like Jamboti, Chigale, Kapoli, Amgaon and Kanakumbi. It lies between two river basins, namely, Malaprabha in the north-east and Mahadayi in the south-west. The Goa road separates the two river basins. The former flows east-wards to join Bay of Bengal and the later that is Mahadayi to the Arabian Sea. The soil is red and the terrain is open. The scattered Zizyphus/Carissa scrub attracts Babblers, Bulbuls, Doves, Mynas and Bee-eaters. Down towards Mahadayi river the 15 km distance from Jamboti to the dam site forms the core area along which in the southern compartments of Chapoli-Amgaon area touching the river bank is a dense moist-deciduous forest coupled with secondary moist-mixed deciduous species. Since they are grown in an undulating terrain the edaphic and biotic factors have helped them to come up very near to semi-evergreen type. In these canopies live many insects, butterflies and birds. We saw /heard on the 17th and 18th of April (1993) Peafowl, Grey Junglefowl, Yellowbrowed Bulbul, Pied Hornbill,Malabar Whistling Thrush, Goldenbacked Woodpecker, Large Green Barbet, Black Bulbul and Storkbilled Kingfisher. On the ground early in the morning we saw Greyfronted Green Pigeon. On ridges and level grounds deciduous trees like *Carya arborea*,

Emblica officinalis were predominant. On streams and river banks ever-green species like *Cinnamomum zeylancium, Symplocos canarana* and *Mangifera indica*,etc. were stocked. The tree composition is made up of *Terminalia belerica, T.peniculata, Dalbergia latifolia.*, Ficus sp., *Randia dumetorum* and shrubs like *Carissa carandes, Clerodendron* and *Helicteres isora* with climbers like *Wagatea* sp. and *Acacia intsia.* We saw Peafowl, Greyfronted Green Pigeon, Emerald Dove, Blossomheaded Parakeet and heard Fairy Blue Bird, Scimitar Babbler, Grey Junglefowl and also saw a Storkbilled Kingfisher. On streams and river banks evergreen tree species like *Cinnamomum zeylanicum, Symplocos canarana* and *Mangifera indica* were stocked. Pug marks of Panther, Bison, Barking Deer and Sloth Bear on soft soil were observed. Frequent low gruff and gruntling sounds coming from a distant valley were also heard. Their natural abodes still exist in and along the river valley close to the dam site.

(B) *The Kabnali Forest Reserve*

It is nearly 2,013.140 acres of open scrub land mixed with cultivated land, between the Khanapur-Jamboti road and Mahadayi River basin, with hamlets like Dhangarwada, Kokanwada, Kabnali, Kirwale etc., looks denuded. A part of the river Malaprabha flows through this area. It lies at an altitude of 1986 feet (msl). This area was surveyed on 24th and 25th April 1993. Large flocks of Redwhiskered Bulbul and small number of Redvented Bulbuls were seen. At lower levels in scattered bushes Whitespotted Fantail Flycatcher, Iora, Magpie Robin and Bush Chat were seen moving with the Bulbuls. Other birds which we observed in the open scrub were Thickbilled Flowerpecker, Bush Warbler, Small Minivet, Cuckoo-Shrike and a couple of Spotted Doves. From the border of the private lands of Kanakapura a secondary growth of underwood trees mixed with scrub and grass-forest begins where, Tickell's Blue Flycatcher was sighted. Hornbills were seen on trees along the forest edge at Rangarook and Jungle Babblers in large Zizyphus bush. We saw a Whitecheeked Bulbul perched on a twig behind the tree *Dillenia pentagyna.*

(C) *Gavali Forest Reserve*

It is situated at an altitude of 2040 feet (msl) in the upper basin of Mahadayi. Much of its eastern area facing the Khanapur Jamboti is bamboo, but, the core area along the river side has thick vegetation of *Diospryos montana, Holigarna arnottinana, Syzygium cumini, Terminalia chebula, T.peniculata* and *Careya arborea* and other evergreen species. On the 28th and 29th April 1993, we recorded Redwhiskered Bulbul, Black Bulbul, Rubythroated Yellow Bulbul, Purple Sunbird, Thickbilled Flowerpecker, Yellow Tit, Shama, Blackbird, Racket-tailed Drongo, Heartspotted Woodpecker, Large Green Barbet, Malabar Grey Hornbill, Laughing Thrush and others. Towards Khanapur-Anmode road the terrain is gradually elevated and is filled with Zizyphus scrub and clumps of bamboo. Few, under wood trees were also present adding to the height and diversity of the flora. Junglefowl and Red Spurfowl dwell in the thickets.

(D) *Krishnapura Forest Reserve*

It is about 1470 acres at an altitude of 300–350 feet (msl) with Bhimgad, Jamgaon, Abnal and Dongargaon as its hamlets. Bird fauna is as much the same as found in the neighbouring reserve Gavali. We visited this reserve on the 5th and 6th May 1993 and recorded Rufous Babbler, Scimitar Babbler, Blackheaded Babbler, and they are important from the conservation point of view as they are old-world species like the kingfishers, hornbills and woodpeckers. The area also holds a good population of *Turdidae* (thrushes), *Muscicapidae* (flycatchers), *Irenidae* (leaf-birds), and *Dicaedae* (flowerpeckers). The trees dominant in the area are *Syzygium cumini, Holigarna arnottiana, Terminalia tomentosa* and the river bank species *Calophyllum apetalum and Hopea weightiana.*

(E) *The Talewadi-Hemmadaga Forest Reserve*

It is 4080 acres and is located at an altitude of 2055 feet (msl) in the southern region of Mahadayi Valley in Khanapur Taluk. Being very close to the border of North Canara Division the bird fauna of that two regions namely Belgaum and Castle-rock overlap here. From conservation point of view the spot is important. This area was visited and surveyed on the 17th and 18th of May 1993. All the important bird families such as, *Turdidae* (thrush), *Timalidae* (babbler), *Campephagidae* (cuckoo-shrike), *Muscicapidae* (flycatcher), *Dicaedae* (flowerpecker), *Irenidae* (leafbird), *Picidae* (woodpecker), *Columbidae* (dove), *Nectarinidae* (sunbird) and even common bird families like *Pycnonotidae* (bulbul), *Sturnidae* (myna) were found. Impressed with such rich diversity of birds in the reserve we could not resist going there again for the second time on the 26th and 27th May 1993.

Conservation outlook

The main pressure affecting the bird population in the area is hunting especially doves, peafowl, junglefowl and hornbill in kabnali and other adjoining areas of Londa and Khanapur. Grazing and habitat destruction along forest edges continue. In one of the compartments of Hemmadaga-Londa area we saw cattle grazing almost in the core area of the jungle. The 20 km width belt of forest in the western region of Khanapur is the only area in Belgaum District that still looks pristine. The practice of cutting down mature and dried up trees in certain areas of Talewadi-Hemmadaga continues. In the interest of birds like woodpecker, barbet and parakeet which nest in the holes of such dried tree they should not be cut at all. Much cause for concern is the recently proposed hydroelectric project in the Valley. It will engulf all the forests over an area of more than 2 km^2 near Krishnapura, Gavali and Talewadi. By any means, it cannot be recreated. Loss of these habitats will further severely affect altitudinal migrants during winter. Warblers are a group of birds which prefer to move to the southern tropics during winter

season. This and other reasons enumerated above very well justify cancellation of the dam to be built in the valley. There is a need to increase research activities on floristic composition and protection efforts including plantation schemes.

Effect of Hydro-electric Project in Mahadayi Valley

Ecologically, wild species in nature are inseparably interlinked with their environment. They cannot be separated without being damaged or destroyed. Particularly trees cannot be handed over to axes or left to the mercy of the engulfing water heights. Nearly one lakh hectares of forest area in Western Ghats has been already consumed and along with it a large size of wildlife habitat by way of mines and power projects. Now eyes are on to Mahadayi Valley. The plan is to produce 300 megawatts of electricity by spending nearly Rs.325 crores. This will take away more than 330 hectares of forest area. It will turn into a small town. Further about 2000 hectares will vanish for human habitation. This will naturally lead to severe ecological imbalance in Malnad Districts. Hence the proposed project should be abandoned in the interest of promoting research, education and wildlife study for future generation.

Conclusions

Being ecologically a sound component of the natural system, the hydro-power project proposed should be cancelled to avert the impending disaster to the evergreen forest biotopes of Mahadayi. More conservation – education programmes be organised and implemented to curb illegal hunting.The Khanapur-Anmode 30 km road should be closed for heavy traffic vehioles. The manganese mining contract be not extended after it terminates in 1995. Cattle grazing should be controlled through effective measures. Aging and dried up trees should be preserved. Cattle breeders should be asked to live outside the reserve areas. Improvements and conversion of roads should also be stopped. More fruit trees should be included in plantation schemes.

The entire piece of Forest land with a width of nearly 20 km in the west of Khanapur Taluk with road boundaries such as Jamboti-Khanapur road in the north; Khanapur-Anmode road to the east of Mahadayi; Khanapur-Gunji-Londa road to its further east and the Londa-Anmode road touching the border line of North-Canara Division be declared a Sanctuary.

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Appendix 1
Annotated checklist of birds seen in the forest reserves of Mahadayi Valley in Western Ghats April & May 1993

SPECIES	ABUNDANCE					ALTITUDE (FEET)	HABITAT
	A	B	C	D	E		
1. Common Myna *Acridotherus trystis*	5	2	-	2	–	400-2000	f, c, e
2. Brahmny Myna *Sternus pagodarum*	1	2	-	-	1	500-2040	f, c
3. Greyheaded Myna *Sturnus pagodarum*	1	-	-	-	1	1995-2055	c
4 Jungle Myna *Acridotheres fuscus*	3	6	-	-	5	1995-2055	b, c-
5. Redvented Bulbul *Pycnonotus cafer*	2	15	1	2	3	400-2000	a,d.,f
6. Redwhiskered Bulbul *Pycnonotus jocosus*	3	50	10	2	4	1995-2050	d, b
7. Whitecheeked Bulbul *Pycnonotus leucogenys*	-	-	1	-	1	2055	b,
8. Blackbulbul *Hypsipetes madaga-*	*1*	-	*1*	-	*2*	*1995-2055*	*a, b*
9. Yellowbrowed Bulbul *Hysipetes indicus*	-	-	-	-	1	2050	
10. Rubythroated Yellow Bulbul *Pycnonotus melanicterus*	-	-	1	-	-	2040	b,

11.	Whitebrowed Bulbul *Pycnonotus luteolus*	-	1	-	-	-	1986	c,
12.	Littlespider Hunter *Archnothera longiro-ttris*	1	-	-	-	1	2055	b,d,
13.	White-Eye - *Zosterops palpebrosa*	-	-	-	-	6	1995-2055	f,b
14	Purple Sunbird *Nectarina asiatica*	5	-	2	-	2	500-2000	e,f
15	Small Sunbird *Nectarina minima*	-	-	-	-	2	2055	b,
16	Purplerumped Sunbird *Nectarina zeylonca*	2	-	-	-	1	1995-2055	e,f,
17	Thickbilled Flowerpecker *Dicaeum agile*	2	2	3	4	2	500-2000	b,c,d,e
18	Tickell's Flowerpecker *Dicaem erythrorhyncus*	-	1	-	-	1	1995-1986	b,c
19	Nilgiri Flowerpecker *Dicaeum concolor*	-	-	-	-	4	2055	b,
20	Yellow Wagtail *Motacilla flava*	1	-	-	-	-	1995	c,
21	Velvetfronted Nuthatch *Sitta frontalis*	1	-	-	-	1	1995-2055	a,b ,
22	Spotted Grey creeper *Salpornis spilonotus*	-	-	-	-	1	2055	b,
23	Grey tit *Parus major*	1	-	2	-	2	1900-2000	b, c, f,
24	Southern Yellowcheeked Tit *Parus xanthogenys*	-	1	1	-	2	1800-2050	e, f,
25	Pied Bushchat *Saxicola caprata*	2	-	-	1	2	1980-2010	e, f,
26	Magpie Robin *Copsychus saularis*	-	1	-	-	2	1900-2000	d, f,
27	Shama *Copsychus malabaricus*	1	-	1	-	1	2055	b, c, d,
28	Malabar Whistling Thrush *Myiophoneus horsefieldii*	1	-	1	1	-	500-1000	a,
29	Whitethroated Ground Thrush *Zoothera citrina*	-	1	-	-	1	2055	b, d,
30	Blackcapped Black Bird *Turdus merula*	1	-	1	-	-	2040	a, b,
31	Smallbilled Mountain Thrush *Zoothera dauma*	-	-	1	-	-	2040	b,
32	Tickell's Blue Flycatcher *Musicapa tickelliae*	1	1	-	-	2	1900-2000	d, b,
33	Nilgiri Verditer Flycatcher *Musicapa Albicaudata*	1	-	-	1	1	1995	c,a,
34	Black and Rufous Flycatcher *Musicapa nigrorufa*	1	-	-	-	1	1900-2000	a, b,
35	Whitebellied Blue Flycatcher *Musicapa pallipes*	-	1	-	-	1	2055	b, c,
36	Paradise Flycatcher *Terpsiphone paradisi*	-	-	-	-	2	1995-2055	d,
37	Whitespotted Fantail Flycatcher *Rhipidura albicolis*	1	1	-	-	1	1995-2055	a, b, f
38	Blacknapped Monarch Flycatcher *Monarcha azurea*	-	-	-	-	1	2055	a
39	Common Iora *Agethina tiphia*	1	4	2	-	4	500-2000	b, c, f

40	Gold-fronted Chloropsis *Chloropsis aurifrons*	2	-	1	-	3	1995-2055	a, b, c
41	Jerdon's chloropsis *Chloropsis cochin-chinensis*	1	-	-	-	-	2050	a, b
42	Fairy Bluebird *Irena puella*	1	-	-	-	2	1995	a, b
43	Small Minivet *Pericrocotus cinnamomeus*	6	1	-	-	3	1995-2000	b, c, f
44	Scarlet Minivet *Pericrocotus flammeus*	4	-	-	-	2	2000	b, c, d, f
45	Rosebellied Minivet *Pericrocotus erythropygius*	-	-	-	-	1	1995	d
46	Large Cuckoo Shrike *Coracina novaehollandae*	1	1	1	-	1	1980-2000	b, c
47	Plaintive Cuckoo *Cacomantis passerinus*	1	-	-	-	-	2000	a, b
48	Common Hawk Cuckoo *Cuculus varius*	-	-	-	-	1	2055	a, b
49	Common Indian Cuckoo *Cuculus micro pterus*	1	1	1	1	1	500-2000	a, b, c
50	Blackheaded Cuckoo Shrike Coracina melanoptera	2	-	-	-	1	1995	b, c
51	Koel *Eudynamis scolopacea*	2	1	-	-	-	1995	b, f
52	House Crow *Corvus splendens*	1	1	-	-	1	1980-2000	f, e, g
53	Jungle Crow *Corvus macrorhynclos*	1	-	1	-	1	2040	a, b
54	White Bellied Tree Pie *Dendrocitta leucogastra*	1	1	-	-	2	1980-2055	b, c
55	Southern Large Racket Tailed Drongo *Dicrus paradiseus*	-	-	1	-	1	2040-2050	a, b, d
56	South Black Drongo *Dicrurus macrocercus*	-	1	-	1	1	1000-2000	d, b
57	Haircrested Drongo *Dicrurus hottentotus*	-	-	-	-	1	2055	d
58	Wiretailed Swallow *Hirunda smithii*	2	-	-	-	-	1995	g
59	Crested Tree Swift *Hemiprocne longipennis*	-	-	-	-	1	2055	b
60	Golden Oriole *Oriolus oriolus*	3	1	-	-	4	2000	b, c, d
61	South Indian Black Headed Oriole *Oriolus xanthornus*	-	-	-	-	1	2055	b
62	Heartspotted Woodpecker *Hemicircus canente*	1	-	1	-	2	1900-2000	a, b
63	Yellow-Fronted Pied Woodpecker *Picoides mahrattensis*	1	1	-	-	1	2040-2055	a, b
64	Lesser Goldenbacked Woodpecker *Dinopium benghalens*	1	-	-	-	1	2055	a, b
65	White Breasted Black Woodpecker *Dryocopus javensis*	-	1	-	-	1	1995-2050	a, b
66	Rufous Woodpecker *Micropternus brachyurus*	1	-	-	-	-	2055	a
67	Crimson-Breasted Barbet							

	Megalaima haemacephala	2	3	1	10	2	500-2000	a, b, c, f
68.	Large Green Barbet *Megalaima zeylanica*	2	2	1	1	3	2000-2055	a, b, c, f
69.	Malabar Grey Hornbill *Tocus griseus*	1	1	-	-	1	500-2000	b, c
70.	Common Grey Hornbill *Tocus birostris*	2	1	1	3	4	500-2000	b, c, f
71.	Indian Great Pied Hornbill *Buceros bicornis*	1	2	-	2	1	500-2000	a, b
72.	White-Breasted King Fisher *Halcyon smyrnensis fusca*	1	1	-	1	-	1995-2055	b, g
73.	Stork -Billed Kingfisher *Pelargopsis capensis*	1	-	-	-	1	2000	a, b
74	Indian Roller *Coracias benghalensis*	-	-	-	-	1	2055	d, e
75	Rufous-Backed Shrike *Lenius schach erythronotus*	-	-	-	-	1	2055	d
76.	Southern Crow Pheasant *Centropus sinensis*	-	1	1	-	1	1980	b, e, f
77.	Southern Blossom-Headed Parakeet *Psittacula cynocepha*	2	1	-	-	5	500-2000	b, c, f
78.	Roseringed Parakeet *Psittacula kremeri*	2	3	2	-	1	1900-2000	b, f
79.	Indian Lorikeet *Loriculus vernalis*	2	-	-	1	-	1995	a, b, f
80.	Alexandrine Parakeet *Psittacula eupatrica*	-	1	-	1	1	1900-2000	b, c, f
81.	Western Turtle Dove *Streptopalia orientalis*	1	-	-	1	-	1995	c, f
82.	Roufous Turtle Dove *Streptopelia sp.*	2	1	1	1	2	1986-2000	d, c, f
83.	Spotted Dove *Streptopelia chinensis*	1	4	-	1	2	500-2000	b, d, f
84.	Greyfronted Green Pigeon *Treron pompadora affinis*	5	3	-	-	-	1986-1995	b, f
85.	Maroon Backed Imeprial Pigeon *Ducula badia*	1	1	-	1	-	1996-2000	a, b, f
86.	Nilgiri Wood Pigeon *Columba elphinstoni*	2	-	-	1	-	2055	a, h
87.	Emerald Dove *Chalcophaps indica*	2	-	-	1	1	1995	a, b
88.	Indian Pea Fowl *Pavo cristatus*	2	-	-	-	1	2000	a, b
89.	Grey Jungle Fowl *Gallus sonneratii*	-	-	1	1	2	1995	b, d
90	Red Spur Fowl *Galloperdix spadicea*	-	-	-	-	2	2055	d
91.	Barn Owl *Tyto alba*	-	-	-	-	1	2055	c
92.	Nightjar *Caprimulgus asiaticus*	-	-	1	-	1	2055	b, d
93.	Brown Wood Owl *Strix leptogrammica*	-	-	-	1	-	2000	b
94.	Wynaad Laughing Thrush *Garrulax delesserti*	1	-	-	1	-	1900-2000	a, b
95.	Roufous Babbler							

	Turdoides subrufus	-	5	-	6	7	1995-2055	b, c, d, f
96.	Whiteheaded Babbler							
	Turdoides affinis	-	-	-	-	6	2050	f
97.	Jungle Babbler							
	Turdoides striatus	-	5	-	-	-	1986	b, d
98.	Scimitar Babbler							
	Pomatorhinus schisticeps	-	-	4	-	3	1900-2000	a, b
99.	Blackheaded Babbler							
	Rhopocichla atriceps	2	-	-	-	4	1995-2055	a, b, d
100.	Chestnutheaded Bee-Eater							
	Merops leschenaulti	-	-	-	-	2	1900-2000	b, d
101.	Green Bee-Eater							
	Merops orientalis	-	2	-	3	1	1986-2000	b, d, f
102.	Bluebearded Bee-Eater							
	Nyctyornis athertoni	-	-	1	1	-	2040	a, b
103.	Southern Trogen							
	Harpactes fasciatus	-	-	1	2	-	2040	a, b
104.	Wren Warbler							
	Prinia socialis	-	1	-	1	-	500-2000	e, f
105.	Hoopoe							
	Upupa epops	-	2	-	-	-	1980	e, f
106.	Cattle Egret							
	Bubulcus ibis	-	3	-	2	-	2055	d, e
107.	Pond Heron							
	Ardeola grayii	-	1	-	-	1	1900-2000	g
108.	Whitenecked Stork							
	Ciconia episcopus	-	10	-	-	-	1986	e
109.	White breasted Water-hen							
	Amaurornis phoenicurcus	-	-	-	-	2	2055	g
110.	Redwattled Lapwing							
	Venellus indicus	-	-	-	-	1	2055	e
111.	Black Eagle							
	Ictinaetus malayensis	-	-	-	-	1	2050	h
112.	Pariah Kite							
	Milvus migrans	-	1	-	-	-	1986	h

Forest Reserves Codes

A-CHAPOLI:(Chapoli, Jamboti, Amgaon, Chigale, Kapoli & part of Kanakumbi localities)

B-KABNALI: (Kabnali, Kirawale, Dhangar, Rangarook, Dongarwadi, Manturga, and roadside localities between Jamboti and Khanapur)

C-GAVALI:(Gavali, Pasoli, Hanbarga, Rawatwad, Shiroli, Tipoli & Gunji localities)

D-KRISHNAPURA: (Krishnapura, Bhimgad, Jamaon, Abnal, Dongargaon & other localities towards Gunji & Londa)

E-TALEWADI: (Talewadi, Parli, Devgaon, Hemmadaga, Hambarwadi & other roadside localities between Londa & Anmode)

Habitat codes

a - Primary forest (Bankside); b - Secondary forest; c - Forest edge; d - Zizyphus/Bamboo scrub; e - Agricultural/ Deforested area; f - Roadside trees; g - Waterbody (river); h - Aerial

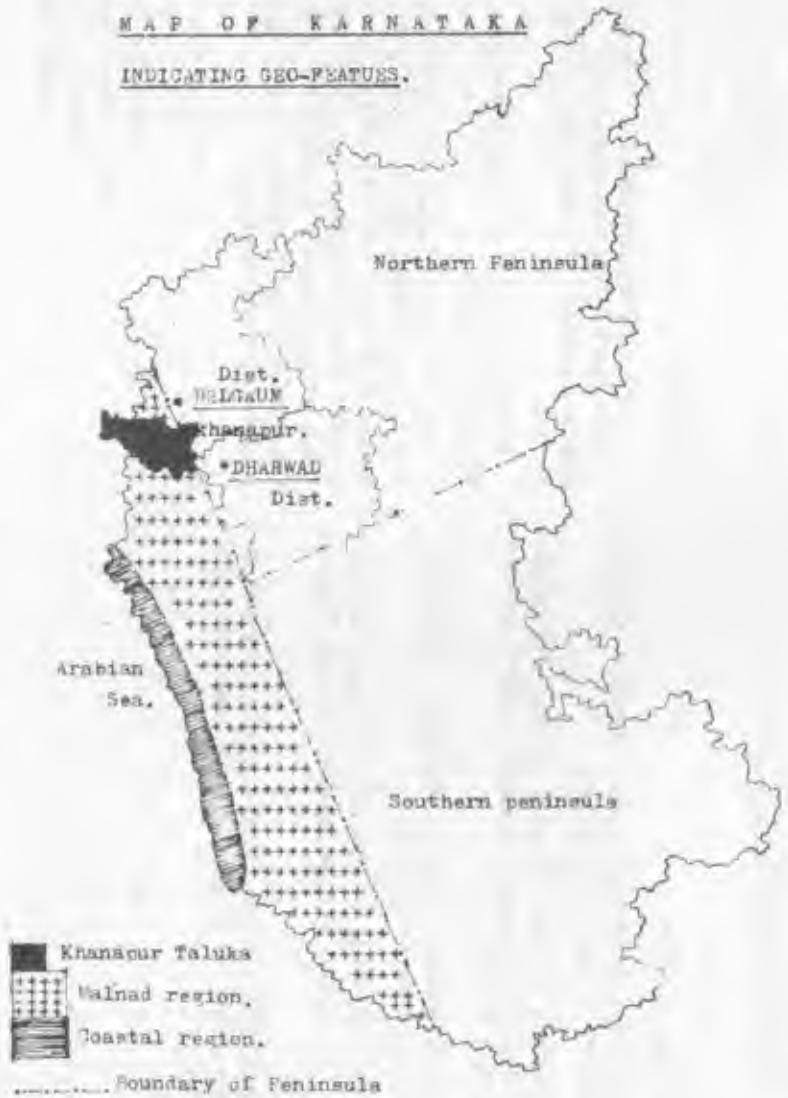
SITE CODE: 15°41' & 15°30' S. longitude & 74°8' East latitude., ALTITUDE

Note : The bird species listed above were identified both from their distinct calls from viewing through a pair of binoculars (8 x40). The bird list is also the first ever to be recorded from the Reserve Forests of Mahadayi River Valley within civil limits of Khanpur Taluk, District Belgaum, Western Ghats (India). A few birds photographed in their natural habitats are appended.

MAP I

MAP OF KARNATAKA

INDICATING GEO-FEATURES.



MAP II

MAP OF KHANAPUR TALUKA
SHOWING BOUNDARIES OF FOREST
RESERVES IN MAHADAYI VALLEY.

A. Chapoli reserve.
B. Kabnali "
C. Gavali "
D. Krishnapura
E. Talewadi. "

Map of India

Showing Karnakata State Boundaries

Density of Water Birds at Vedanthangal Bird Sanctuary, Tamil Nadu

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Introduction

Although a considerable amount of wetland research exists in India, majority of the reports are on selected and well known sites (Wolstencroft *et al.*, 1989). Vedanthangal water bird sanctuary has been existing officially from 1936; but very few scientific studies have been conducted here. Observations of Spillet (1966) is the only available detailed account about the sanctuary. Thangam (1956), Krishnan (1961), Aslam (1966), Badran (1981), Saldana (1976) and Santharam and Menon (1991) have all made interesting observations.

The density and diversity of water birds are influenced by rainfall, temperature, humidity and cloudiness (Custer and Osborne, 1977; Goss-custard, 1985; Teylor and Pollock, 1985 and Briggs and Holmes, 1988). Rainfall has great influence on the Magpie Geese population (Baylis, 1989) and cold weather causes many fowls to leave wetlands (Salmen, 1988). Water depth is reported to influence the population of migratory water birds (Sayre, 1984; Poysa, 1989 and Vijayan, 1990).

Hence, the present work was undertaken to study the water bird population in relation to rainfall, temperature, humidity and water level of the lake in the Vedanthangal water bird sanctuary.

Material and Methods

Study Area

Vedanthangal is situated about 50 km to the South-West of Madras and is 120 m above mean sea level. It is about 50 kms inland from the Bay of Bengal and receives about 1140 m of rainfall per year; mostly from the North-East monsoon between October and December. The lake comprises an area of 30 hectares (Fig.3). A long bund along the western side impounds the water and is bordered by agricultural lands. Apart from the huge Maduranthagam Tank, there are about 60–70 smaller tanks scattered around this sanctuary. Four small canals feed the Vedanthangal tank. Thirteen species of birds nest in this lake (Table 1) on *Barringtonia acutangula* groves in the lake beds. They become submerged when tank fills up, leaving only the top branches exposed. Originally this tank was 550 *Barringtonia* trees (Krishnan, 1961). The Tamil Nadu Forest Department planted *Accacia nilotica* and now there are more than 5000 trees (Paulraj, 1984).

The present work was conducted from October 1992 to April, 1993. The climatic data were collected from the meteorological station at Maduranthagam (Table 2).

A watch tower on the top of a bund was the main censusing station. A pair of binoculars (10 × 80) mounted on a stand was used. Counts were made by slowly scanning the colony from one end to the other. The count of birds returning to roost in late evening was done using the block method (Howes and Bakewell, 1989).

Results and Discussion

The climatic and hydrographic data and the number of birds found during the study period are given in Fig.1. The delayed North- East monsoons started in November, 1992 and gradually filled the tank. The arrival of birds started in late October and attained peak at February, 1993. When the water level became low during April, 1993 almost all the birds left the sanctuary. Significant correlation (r=0.8217) was obtained between the water level and the bird population. Other climatic factors viz., temperature (r=-0.620 for maximum and -0.976 for minimum), rainfall (r=- 0.2675) were negatively correlated with bird population. The peak observed during January and February, 1993 was due to the continuous arrival and breeding of birds. In the consecutive months the population declined with the reduced level of water. Linear regression analysis showed a clear picture of the relationship between water level and bird population (Fig.2). Availability of suitable nesting sites, dispersal pattern of the young, differential rate of fledgling survival and changes in the environmental condition also influence the species number as observed by Santharam and Menon, (1991).

Cormorants and Grey Herons arrived earlier at this sanctuary and they accounted for 75.56% and 24.44% of the total bird population during October 1992. This composition was altered by the arrival of more Cormorants during November 1992. During December, the Cattle Egret composition reached its peak (53.78%) and the next dominant was Cormorant (32.74%). During January and February 1993, these two species were predominant and Grey Heron, Openbilled Stork, White Ibis, Cormorants were in smaller proportions. Remarkably almost all the Cattle Egrets left this sanctuary during March 1993 and the dominant ones were Cormorants and White Ibis. Dabchick composition increased remarkably during April, 1993 but the Cormorants were still dominant (Table 3).

Except a few species, almost all the birds bred during this season (Table 1). The Grey Pelicans, which are not regular visitors of the sanctuary began nesting in fairly good numbers. Unfortunately, when the water level became lower they left the eggs and flew to favourable places. Out of 5 pairs of Painted only one succeeded in breeding. Similar observations were made by Santharam and Menon (1991) for 1990. Cattle Egret does not breed in this sanctuary during this season. But Krishnan (1961) recorded that some negligible proportion breed, and further reported that they use this sanctuary mainly to roost. The present work and earlier observations (Santharam, 1987, 1988, 1989 and Santharam and Menon, 1991) indicated that the Cattle Egret was a winter visitor to the sanctuary and their movements are regulated by monsoons. Observations on the cormorants indicated that they are the

good breeders here as they are present throughout. Earlier reports mentioned that Little Egrets are the most numerous nesting birds of this sanctuary (Krishnan, 1961 and Spillet, 1966). Now they are on the decline. During the present study, a second clutch of Openbilled Stork was observed, but it failed to hatch due to low water level and poaching.

Conservation Problems and Suggestion

Recent changes in the land use and crop growing patterns in the neighbourhood of Vedanthangal are noteworthy. Several fields adjacent to the tank have been left fallow. In others crops like Paddy and sugarcane, have given way to crops such as groundnut. This may restrict the foraging habitat available for shallow feeders such as Egrets, White Ibis, etc. As pointed by Krishnan (1961, 1978) and Spillet (1966), birds of Vedanthangal greatly depend on the nearby wetlands, paddyfields and scrubjungles. Mere protection given at the nesting site alone cannot ensure conservation of the heronry.

Although this is called "Vedanthangal water bird sanctuary", it does not come under the Wildlife (Protection) Act, 1972 section 18. Fishing, grazing and bird hunting in the sanctuary by local people are frequent. Paulraj (1984) opined that stern action could not be taken against the misusers by the Forest Department as this lake does not belong to them. The lake and canals should be deepened every year to impound sufficient water. Provision of a dry stone wall around the entire sanctuary may protect it from cattle grazing.

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Table 1 : A list of breeding waterbirds of Vedanthangal

Common Name	Scientific Name
Little Egret,	*Egretta garzetta*
Smaller (Medium) Egret,	*E. intermedia*
Large Egret,	*Ardea alba*
Grey Heron,	*Nycticorax nycticorax*
Pond Heron,	*Ardeola grayii*
Little Cormorant,	*Phalacrocorax niger*
Large Cormorant,	*Phalacrocorax carco*
Darter,	*Anhinga rufa*
White Ibis,	*Threskiornis aethiopica*
Spoonbill,	*Platalea leucordia*
Spottedbilled or Grey Pelican,	*Pelicans philippensis*
Painted Stork,	*Mycteria leucocephala*
Openbilled Stork,	*Anastomus oscitans*

Table 2 : Climatic Factors and Bird Population during the Study Period

Year & Month	Temperature Max. (c)	Min.	Total Rainfall (mm)	humidity (%)	Relative level (m)	Water Bird Population												
						GH	OBS	WI	GI	SB	C	CE	P	D	PS	GP	DR	Total
1993																		
Sep	34.73	25.78	22.0	82.07	0.20	–	–	–	–	–	–	–	–	–	–	–	–	–
Oct	32.67	24.28	87.3	86.86	0.4	11	–	–	–	–	34	–	–	–	–	–	–	45
Nov	29.58	23.35	129.9	87.55	2.4	32	–	–	–	–	358	110	–	–	–	–	–	500
Dec	28.60	20.46	40.4	74.86	2.6	119	95	321	46	87	1763	2896	57	1	–	–	–	5385
1993																		
Jan.	29.36	19.52	10.1	85.44	3.4	125	297	276	37	91	2978	3111	–	–	–	–	–	6915
Feb.	30.44	20.06	–	73.43	2.8	107	436	341	37	95	4005	3321	–	–	10	150	12	8514
Mar.	31.45	21.97	–	73.25	1.6	22	237	1024	–	11	1910	–	–	–	1	2	11	3218
Apr.	32.43	23.25	–	73.65	0.8	11	–	21	–	–	46	–	–	32	–	–	–	110

GH – Grey Heron OBS – Openbilled stork WI – White Ibis GI – Glossy Ibis SB – Spoonbill C – Cormorant
GE – Cattle Egret P – Pintail D – Dabchick PS – Painted Stork GP – Grey Pelican DR – Darter

Table 3 : Percentage Composition of various birds during the study period

Bird Species	Month						
	October	November	December	January	February	March	April
GH	24.44	06.10	02.21	1.81	1.25	00.68	10.00
OBS	–	–	01.76	4.29	5.12	07.36	–
WI	–	–	05.96	3.99	4.01	31.82	19.09
GI	–	–	00.84	0.53	0.43	–	–
SB	–	–	01.62	1.32	1.12	0.35	–
C	75.56	71.60	32.74	43.07	47.04	59.35	41.82
CE	–	22.00	53.78	44.99	39.01	–	–
P	–	–	01.06	–	–	–	–
D	–	–	00.02	–	–	–	29.09
PS	–	–	–	–	0.12	0.03	–
GP	–	–	–	–	1.76	0.07	–
DR	–	–	–	–	0.14	0.34	–

GH – Grey Heron OBS – Openbilled Stork WI – White Ibis
GI – Glossy Ibis SB – Spoonbill C – Cormorant GE – Cattle Egret
P – Pintail D – Dabchick PS – Painted Stork
GP – Grey Pelican DR – Darter

Fig. 1 : Climatic factors and bird population in the Vedanthangal Bird Sanctuary

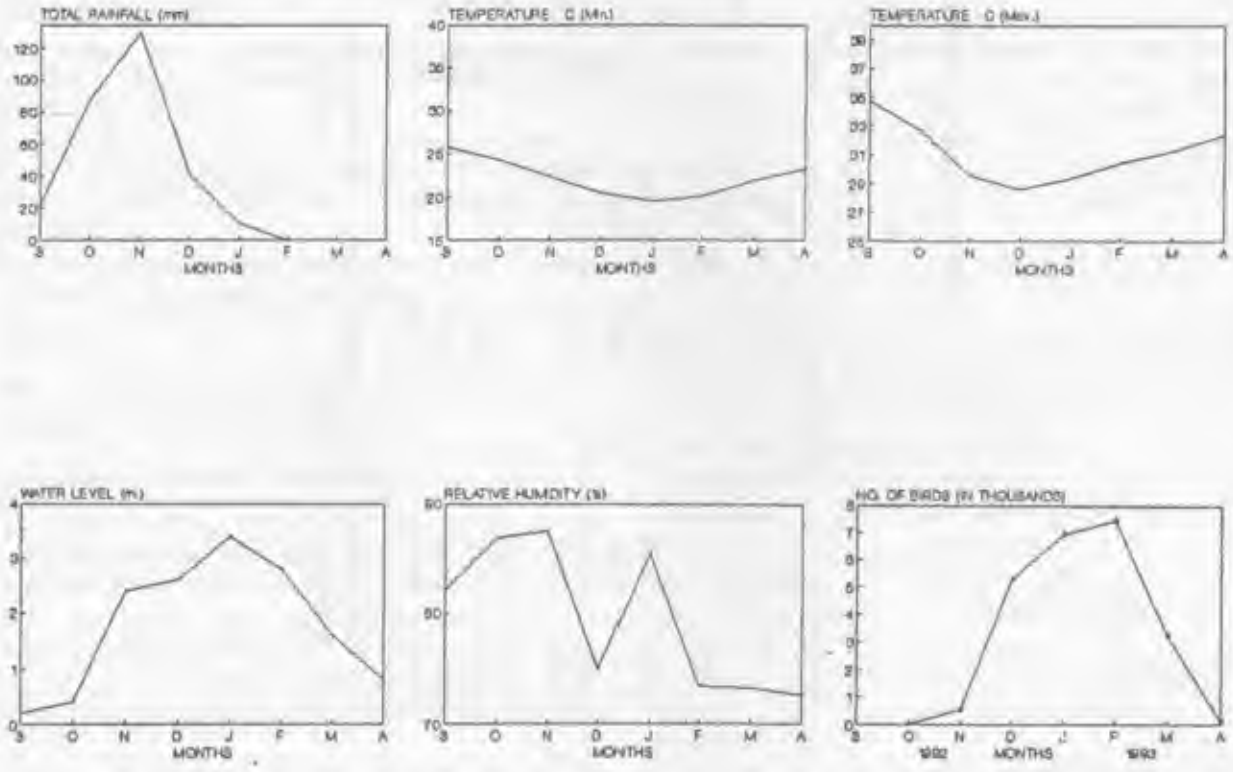
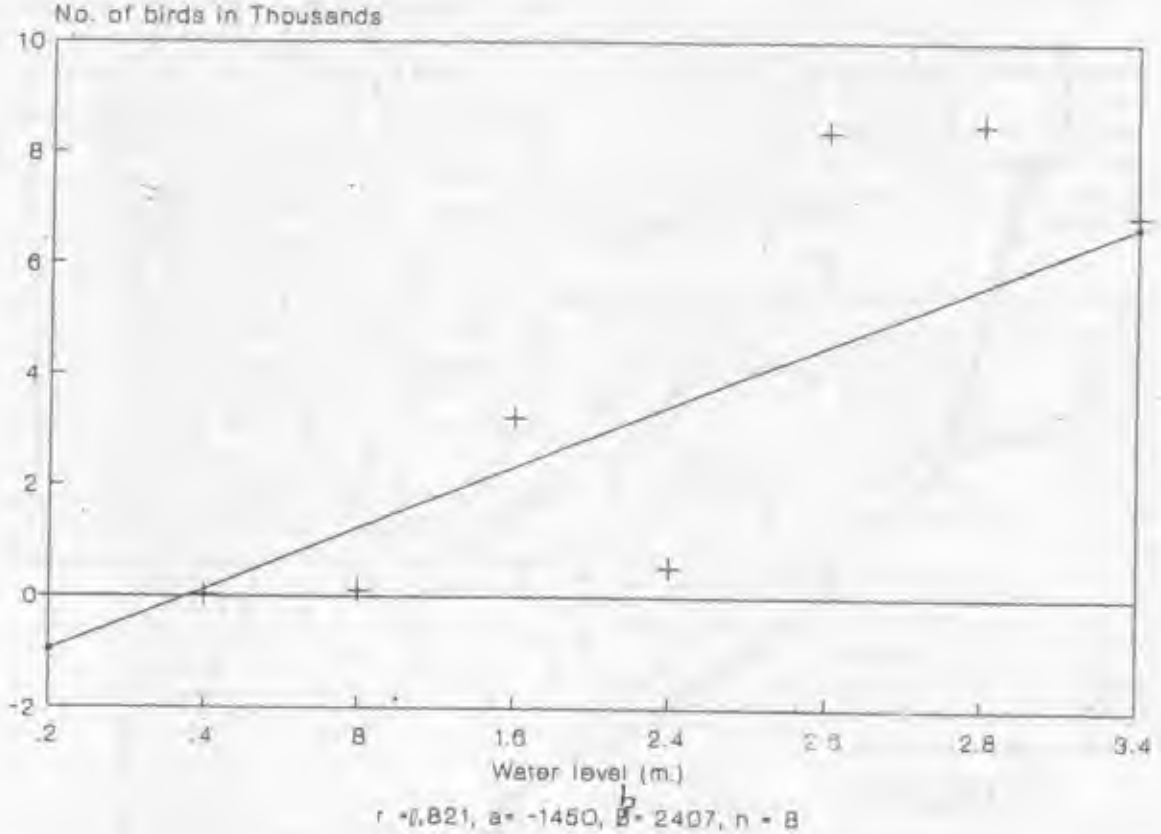
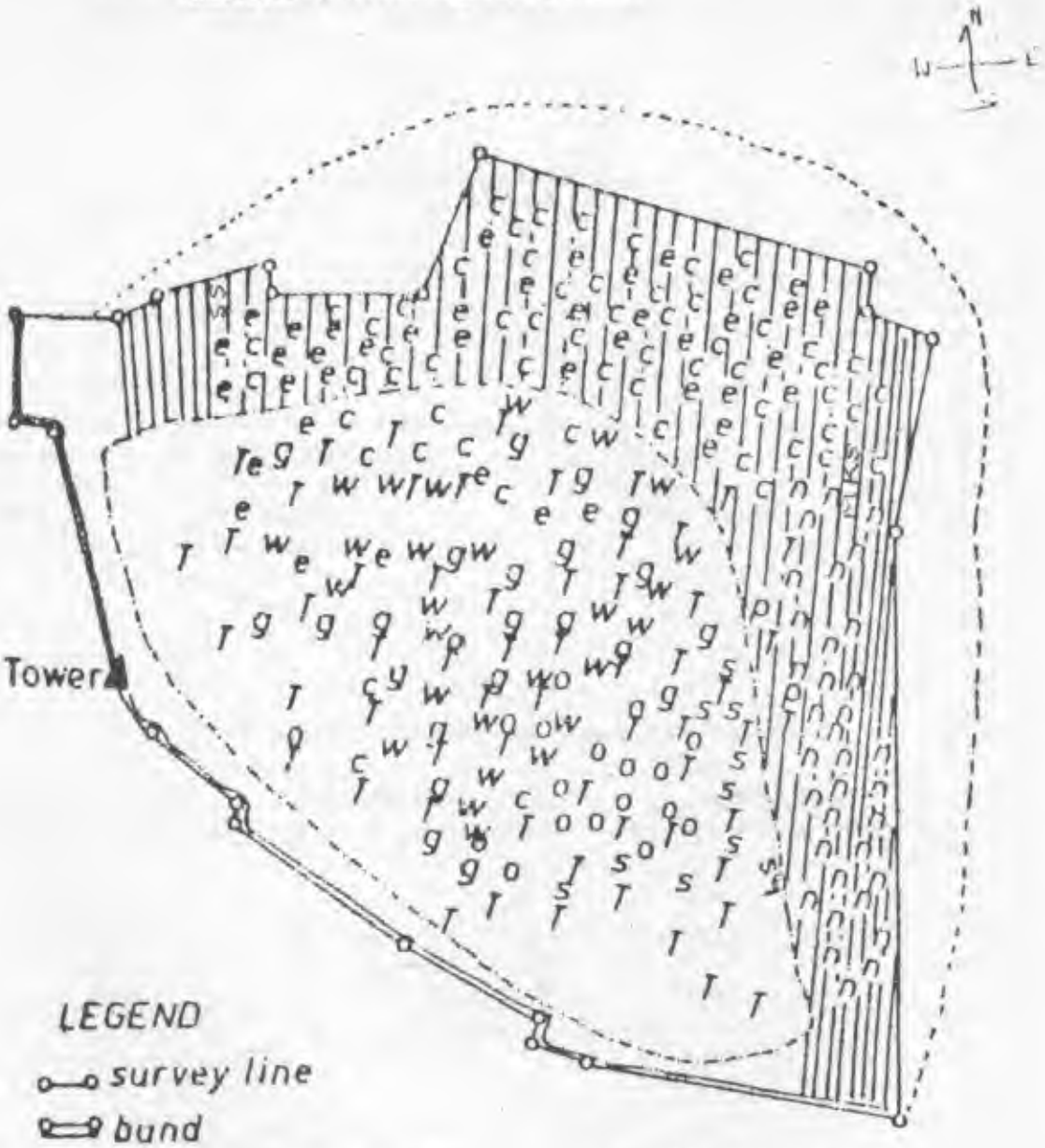


Fig. 2 : Regression of Bird Population
VS Water Level



r =0.821, a= -1450, b= 2407, n = 8

Fig. 3 : Vedanthangal Sanctuary Tank
Distribution of trees and grouping of birds



LEGEND

survey line

bund

..... water spread area

—.— central core

||||||| Acacia trees

T : Barringtonia trees

e : Egrets

c : Cormorants

n : Night+Herons

g : Grey Herons

o : Openbilled Stork

s : Spoonbills

w : White Ibis

p : Pelicans

scale : 1 mm = 3690 mm

Tank area : 29.5 Hac

Decline of Green Pigeon *Treron phoenicopters* in Coorg District in the Last Three Decades

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Green Pigeons are local migrants to the Malnad areas during the post monsoon season (September-October). They come in small flocks and congregate on large fruit-bearing trees like the *Ficus* sp. Their abundance in the last three decades are given in Table 1. This clearly shows that the Green Pigeons have become a very threatened bird in Coorg; the main reason being indiscriminate shooting, as their flesh is very tasty.

The game is believed to have started in the later part of the last century by the British coffee planters who had thousands of acres of coffee plantation, lot of leisure and plenty of guns and ammunition. They later started supplying the guns and cartridges to their butlers who used to shoot the poor creatures in mass, cook and serve as a prestigious delicacy. Gradually the locals picked up the taste and the merciless killing continued with the availability of improved guns and cartridges. One can still hear some people boast about shooting down 10–12 or more birds in a single shot (mostly from 12 bore guns with cartridges loaded with chilled shots).

Observation behaviour pattern (Table 2) have shown that Green Pigeon after feeding on fruits tend to bask on exposed trees, thus making them vulnerable to hunters.

Table 1: Pigeon Depletion in Coorg

Decade	Abundance	Remarks
1961–70	Very Abundant >200 pigeons /*Ficus* tree	Post British era; Land less fragmented. Effect of shooting less felt.
1971–80	<100/*Ficus* tree	Land fragmentation. Felling of trees in plantation areas. Easy availability of ammunition.
1981–92	Between 10 and 20/*Ficus* tree	High fragmentation of land. High exploitation of wild fruiting trees. More number of hunters.

Exploitation of the bird flesh through hunting has increased over the last three decades as given in Table 1, due to land fragmentation (thus increasing the number of unit hunting areas), improved ammunition and high population (consequently more number of hunters). As a result Green Pigeons are a threatened species here.

Today one can hardly see a flock of even ten and seldom hear the pleasing whistle from their flute like voice. An environment conscious visitor to the Western Ghats certainly miss, these whistling visitors. It is urged through this paper that shooting of Green Pigeons be banned, otherwise this pigeon may also go the way of Passenger Pigeon.

Table 2: Behaviour pattern of Green Pigeon

Between	Behaviour pattern	Remarks
06.30–08.00 a.m.	Arrival to the foraging tree in small flocks, from the roost	Whistling and call seldom heard Difficult to locate
08.00–09.00 a.m.	Active foraging (if left undisturbed)	due to high obliteration among foliage.
09.00–10.00 a.m.	Move to bare lofty trees after feeding, in ones and twos; utters whistling call, and cleans the beak and feathers; basking in the interm ittent morning sun, of the monsoon	Most vulnerable to shooting, as they are exposed. Seems to enjoy mild drizzle at this post-feeding phase.
10.00–03.00 p.m.	Fly to dense forest canopies	Difficult to locate, except by the typical spiral droppings on ground below
03.00–06.00 p.m.	Arrival to foraging tree and basking in sun (evening); the morning sequence repeated. Here arrival is preceded by a few birds first (scouts ?)	Again vulnerable to shooting, but few birds on alert
After 06.00 p.m.	Roosting	Occurs very silently and difficult to locate

Preliminary Study on Ecology of Aquatic Birds in Chilika Lake, Orissa

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Introduction

Chilika lake in Orissa, covers 1100 sq km and is the largest brackish water wetland in the country. The Ramsar convention, 1971 notified Chilika lake as one of the internationally important wetlands. The Chilika lake is connected to the Bay of Bengal at its North-east through a narrow opening and subjected to minor tidal fluctuations. It receives fresh water from the major rivers like Daya and Bhargavi and several small local streams. The total area of the wetland was declared as a closed area under Orissa Forest shooting rules during 1973. Since December, 1987 the Nalaban Island which is one of the most potential submerged islands, covering 15.53 sq km has been declared a Wildlife sanctuary under the Wildlife (Protection) Act, 1972. This wetland abounds with a variety of aquatic flora (Adhikary and Sahu, 1991 and 1992; Patnaik, 1973) and fauna (Annandale, 1915; Sarma *et al.*, 1980; Patnaik, 1986; Rao, 1987; Murthy, 1987; Murthy and Rama Rao, 1989; Directorate of Fisheries, 1970) including 150 species of migratory birds (Dev, 1992; Hussain, 1988; Khachar, 1966; Kar, 1992).

Material and Methods

Till now, no detail systematic study has been carried out on the avifauna of Chilika lake. A research project on the "Ecology of aquatic birds in Chilika lake" has been implemented since November, 1992 by the Wildlife Wing, Forest Department, Government of Orissa with financial assistance from Government of India.

Results and Discussion

Study conducted during the last migration season indicated that above 0.6 million migratory birds visited this wetland. Majority of migratory birds included Anseriformes, Gruiformes, Charadriiformes, Ciconiiformes, Pelecaniformes, Podicipitiformes, Falconiformes and Coraciiformes. Due to the huge congregation of aquatic birds in this area, special emphasis was given to collect data from the Nalaban Sanctuary (15.53 sq.km. area) and its peripheral areas. Aim of the present report is to give preliminary account of the status, composition, distribution, food and feeding, activities and migration pattern etc. of the aquatic birds in the Chilika lake. It also emphasize that there is need to undertake intensive study on the ecological inter-relationship between physico-chemical properties of water, silt deposit, floral and faunal composition and above all the 'socio- economic' problems to preserve its rich biodiversity. The present study was conducted between November 1992 and March, 1993.

Physical Characteristics

During rainy season Nalban island gets submerged, with average depth of 1.5–2.2 m of water. Then, in winter water level ranges from 0.5 to 1.5 m. There was no rainfall in the area from November to February. During the end of March there was little rains amounting to 0.5 cm.

During the study period, the maximum air temperature recorded, ranged from 21°C to 34°C and the minimum ranges from 18°C to 25°C. The water temperature ranges from 18°C to 27°C. The relative humidity ranges from 75% to 82.2%.

Chemical Parameters

Since Chilika is a brackish water lake, the salinity varies in various months. In the intensive study area the salinity varied from 1.0 ppt to 7.8 ppt. In other areas of the lake the maximum salinity was 7.9 PPT and the minimum was 1.4 PPT during this period.

The chemical analysis of water for testing other important parameters is yet to be started for this project.

Biological Parameters :

Microphytes – 7 species of major aquatic macrophytes have been identified from the Nalaban area which comprises of floating forms, submerged forms and emergent vegetation.

Several algal forms like *Gracilaria lichenoides, Chara sps.* and other submerged forms like *Potamogeton pectinatus, Naja faveolata* and *Hydrilla verticillata* form the major food of migratory water fowl.

Microinvertebrate

Molluscs were the common macroinvertebrates observed in the mud as well as in the weed samples. Arthopods and Annelids were also found in both the samples but in lesser numbers.

Fishes and herpetofauna

By periodical collections and by occasional observations the different species of fishes, amphibians and reptiles were recorded.

Ecology Of Aquatic Birds

In this study major emphasis was given on the aquatic birds and particular importance is given to the waterfowl species of Anatidae and Rallidae which formed the major

winter visitors. A brief account of orderwise population of aquatic birds during these months is given in Table I.

The order — Anseriformes formed 68.67% of the total population followed by Gruiformes (13.48%), Pelecaniformes (0.81%), Podicipediformes (0.05%), Falconiformes (0.03%) and Coraciiformes (0.01%).

During the study period the habitat types of the birds of Chilka has been broadly classified into the following categories.

1. Shallow water covered with weed (0.5–1.5 m)

   Pelican, Dabchick, Pheasant-tailed Jacana, Egrets, Herons, Purple Moorhen.

2. Shallow Clear water (0.5–1.5 m)

   Pintail, Gadwall, Shoveller, Brahminy Duck, Spotbilled Duck, Flamingo.

3. Deep water (1.5 m +)

   Coot, Common Pochard, Tufted Pochard, Pigeon, Redcrested Pochard, Grebe.

4. Shore area

   All waders, Stork, Ibises, Kingfishers.

5. Grassy land

   Barheaded Geese and Greylag Geese for feeding.

6. Rocky lands

   Cormorants, Herons, Egrets, Raptor birds for feeding.

7. Prawn cultivated pens (0.1–1.5 m)

   Majority of the birds mainly for resting and feeding.

Since this is the first season for this study, elaborate analysis on the habitat preference has not been carried out. However, from the available data it was found that, out of 335 observations the birds were seen utilising shallow water for 245 times followed by the shore area.

Major food of Anatids and Rallids were aquatic macrophytes and the macroinvertebrates.

Ringing / Banding Of Birds during the Migration Season

Thirty four aquatic birds belonging to 3 families (Anatidae, Charadriidae and Laridae) were captured and ringed (Table-II). During ringing operations inside the Nalaban Sanctuary, a Caspian tern — (*Hydroprogne caspia*) was captured on 1.1.93. It had a ring with the engraving EB 386947 MOSKWA. After recording its measurement and weight the bird was released. The details about its place of ringing and organization has to be ascertained from BNHS, Bombay.

Mid-winter Waterfowl Census

Mid-Winter waterfowl census was conducted in the Nalban Sanctuary and in the peripheral areas including Gerasar during 21–23rd January, 1993. A total of 6,51,435 birds were counted.

Acknowledgements

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TABLE 1. Population of Aquatic Birds

Order	November 1992	December 1992	January 1993	February 1993	March 1993
Podicipediformes	400	450	505	370	300
Pelecaniformes	4,850	5,040	5,330	5,000	4,660
Ciconiiformes	27,600	28,350	28,883	20,300	15,870
Anseriformes	2,58,790	4,25,180	4,47,371	1,85,800	40,790
Gruiformes	70,700	82,670	87,810	40,350	10,000
Charadriiformes	50,400	671,360	84,236	35,900	12,770
Falconiformes	185	196	200	170	150
Coraciiformes	90	92	100	66	40

TABLE – 2. Ringing/Banding of Birds during the migratory season

					Sex	
					M	F
I. ORDER	:	**ANSERIFORMES**				
i. Family	:	Anatidae				
Pintail	:	*Anas acuta*	3	–	3
Gadwall	:	*A. strepera*	4	4	–
Wigeon	:	*A. Penelope*	6	4	2
Shoveller	:	*A. Clypeata*	7	4	3
II. ORDER	:	**CHARADRIIFORMES**			
I. **Family**	:	*Charadriidae*			
Grey Plover	:	*Pluvialis aquatarola*	1		
Large Sand Plover	:	*Charadrius leschenaultii*	2		
Blacktailed Godwit	:	*Limosa limosa*	1		
Red Shank	:	*Tringa totanus*	2		
Green Shank	:	*T. nebularia*	1		
Little Stint	:	*Calidris minuta*	1		
Dunlin	:	*C. alpina*	5		
II. Family		*Laridae*			
Brownheaded Sea-gull	:	*Larus brunnicephalus*	1		
		Total	34		

Avifaunal Diversity in Different Vegetation Types of Eastern Ghat of Andhra Pradesh

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Introduction

The Eastern Ghat of the Visakhapatnam district, Andhra Pradesh, supports rich avifauna that include Himalayan relics as well as lowland humid forest forms not found in the surrounding plain regions. The Ghat is a low, often plateau like mountain that runs parallel to the coast facing the Bay of Bengal. The average highland area stands about 900 m above sea level, but some of the higher peaks in the North rise above 1500 m. (Ripley *et. al., 1987).*

Two of the great interests in the region were the discovery of the first peninsular population of the Tree Sparrow, *Passer montanus* (Krishna Raju and Price, 1973) and the first record of the Little Spiderhunter, *Arachothera longirostris*. The Visakhapatnam Ghat often referred to as the northern circars, is the one where the mountain chain is the broadest, highest and probably richest in animal life. Ali and Ripley,1983 and 1985; Price,1977,1979 and 1987; Krishna Raju 1985, 1987 and 1989;Ripley,1978; Ripley and Beechler,1985; Ripley *et.al.*, 1987; Beechler *et. al.*, 1987, recorded a number of bird species new to this region. The most important single effort to survey avifauna of the Eastern Ghat was made by the Verney Expedition of the Bombay Natural History Society (Whistler and Kinnear, 1932-39). The survey brought out seven endemic sub-species of birds from the Ghat. Subsequently, this region was visited by Abdulali (1945 & 1953) who added considerably to its list of avian fauna, especially those that were found in the open country and plains of this region. So far 300 species of birds have been recorded from the entire Visakhapatnam Ghat (Krishna Raju, 1985). The avifauna here is threatened by the encroachment of modern civilization. From the review of the above literature it was inferred that studies on census, diversity and relationship with the vegetation is wanting. Hence the present study was attempted on the birds of natural forests and plantation areas.

Material and Methods

The study was carried out from February to July 1988 in the North Eastern Ghat of Andhra Pradesh. The study area, lying at 18°27'N, 82°50'E, had four sites viz., Vizag of Visakhapatnam district, Thatipudi, Pacinimarripalem and Thammapuram of Vizinagaram district. Five different habitats were recognised as (1). Dry deciduous forests (Habitat I) (2). Scrub jungle (Habitat II) (3). Eucalyptus (Plantation area I) 4. Cashew (Plantationa area II) and 5 Teak (Plantation area III) (Fig. 1). The birds were sampled in two ways. One, by point census to determine the number of species which coexist and two, a 100 m transect was chosen in each habitat to census birds for half an hour. The census was taken between 07-10 hrs. and from 15-18 hrs. In each habitat four censuses were conducted from each of the two fixed points per month. At each census all birds that were found 10 m. on either side was recorded. Next, by using 6 mist nets ($3x12m^2$) in each habitat, birds were trapped and counted.

Analytical Method

The bird species diversity (BSD) was calculated using the Shannon-Wiener index (H') (Krebs,1972) :

$$H = \sum_{i=1}^{S} \pi \log \pi$$

where S' represents the number of species, and π denotes the proportion of the total number of individuals of ith species

Species richness (SR) was calculated using Gleasons (1922) formula.

$$SR = \frac{S-1}{\log_e N}$$

where S=Number of species, Log_e N is the natural logarithm of total number of individuals of all species in the count.

To discuss the compostional similarity between the habitats, Jaccard's (1908) index of similarity(J) was applied. This index refers to the ratio of number of species shared to total species numbers among the various entities compared :

$$J = \frac{Nc}{N1 + N2 - Nc}$$

where, Nc = Number of species in common,
N1 = Number of species in the first entity,
N2 = Number of species in the second entity.

Results and Discussion

Habitats and bird species abundance

The samples from different habitats provided an insight into the colonization of birds. The least disturbed and structurally the most complex habitat was surrounded by agricultural fields. The total number of bird species supported by the various types of habitat corresponded with the complexity of the vegetation as inferred from the respective total number of bird species viz., 52, 43, 39, 32, and 27 for the dry deciduous forest, plantation area I, Scrub jungle, plantation area II and plantation area III, respectively (Table 1). Beechler *et al.*, (1987) while reporting on the structure and composition of different

forest types of the North Eastern Ghat at Andhra Pradesh had observed a correlation between abundance of the bird species and the complexity of the vegetation structure. The authors attributed the difference in the bird species composition to the differences in the microhabitat among the sites. Further, they had stated that the reason for the poor bird species composition in the teak plantation to the simple structure and monocultural make up of the plantation.

In the present study, the diversity values (H') were found to be higher in forested areas than in plantation areas (Table. 2). Beechler *et al.*, (1987) also observed a higher bird species diversity in forested areas viz., patchy ravine forest and tropical moist deciduous hill forest than in the plantation areas, namely, coffee and teak. They opined that the bird species diversity was a function of complexity of vegetation structure.

BIRD SPECIES RICHNESS

The species richness value (SR) in the study area varied from 5.18 to 13.68 in the five habitats studied. The maximum value was recorded for the dry deciduous forest. In general, the plantation areas had comparatively lower values. This might be due to the richness of food items in forests with complex vegetation. James and Wamer (1982) while studying the community diversity in tropical bird communities of Central Panama had suggested that the species richness was related to the vegetation structure.

SIMILARITY INDEX

The similarity index in the present study varied from 0.30 to 0.87 (Fig.2) with the lowest value during summer months (April- July) than in other months and that might be due to the lesser availability of food.

Some birds as *Streptopelia chinensis, Dicrurus adsimilis, Corvus macroynchos, C.splendens, Acridotheres tristis, Psittacula krameri and Eudynamys scolopacea* were observed both in forest and plantation areas. This indicated that these species were highly adaptable.

The reduction in size of the forest is expected to lead to the loss of some species (Mac Arthur and Wilson, 1967). In the present study area it was observed that the dry deciduous forest was being destroyed by forest felling for fuelwood and other products. It had already affected population of large birds, such as Peafowl (*Pavo cristatus*) and Indian Pied Hornbill (*Anthracoceros malabaricus*) which were locally extirpated from most forest tracts in Pacinimarripalem during the last 10-15 years (Krishna Raju, per com.). Price (1987) working earlier around Lammasinghi had also reported that several bird species are likely to disappear if the forest cover is lost.

The present study clearly indicated that natural forests which have complex diversity of plant species can support a greater diversity of birds than plantations which are often monocultures dominated by single plant species. It is, therefore, suggested that steps should be taken to prevent the existing tracts of the forest of the Eastern Ghat from exploitation by local people as it is pertinent that the unique avifauna of this area should be protected.

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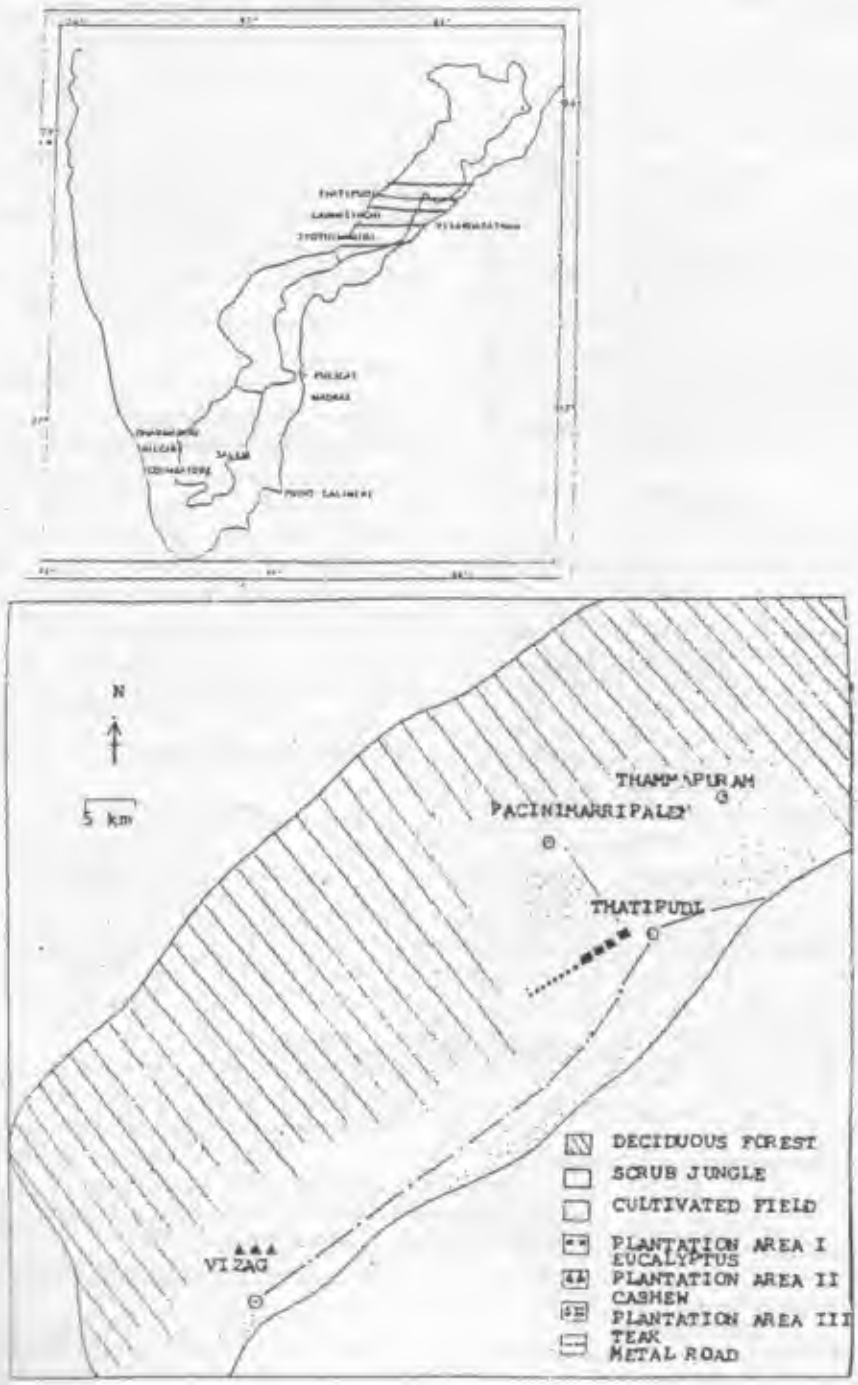
Fig. 1 : Eastern Ghat (Study Sites)



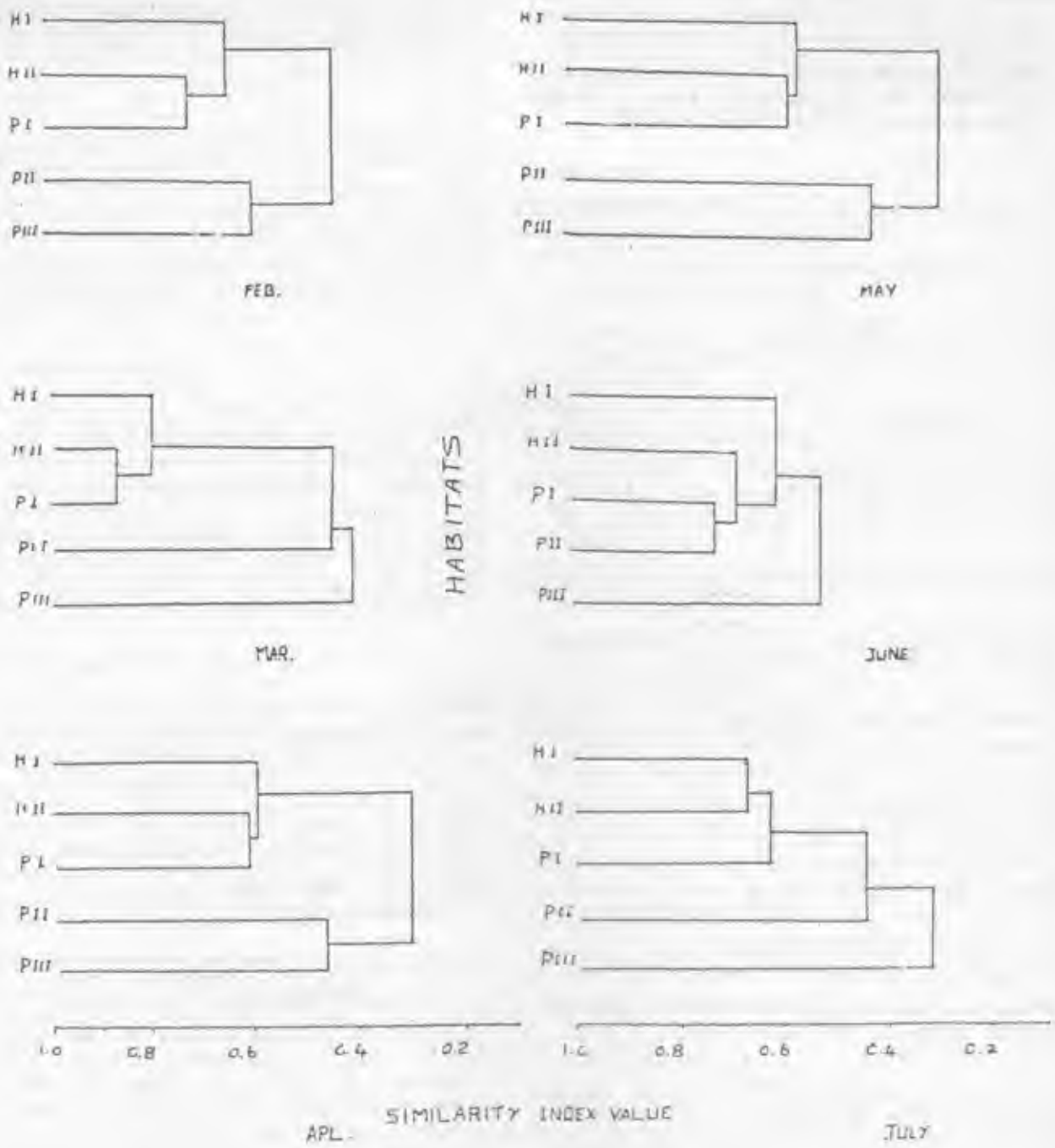


Fig. 2 : Dendrogram showing the similarity for bird species as expressed by its index value, of the various habitats of study area during February to July 1988.

Check List of the Birds on the Madras Christian College Campus from 1990–1993

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Introduction

The Madras Christian College Campus comprises of 365 acres of mixed vegetation, inclusive of the native, dry evergreen plants and the introduced species. Such a variety of plant life naturally encourages a wealth of avifaunal species. Introduction of exotics and plants from other vegetation types have enhanced the density of green cover. The checklist of Barnes (1939) refers to a time when the vegetation was primarily dry evergreen; a total of 83 bird species were recorded. Siromoney's checklist (1971) containing 149 species included observations made when the introduced forest tract was well established. Since 1971, several changes have occurred in the Campus. The advent of the spotted deer (*Axis axis*) in the mid-seventies has had its impact on the vegetation. Large scale deforestation of a native tract has necessitated a redistribution of bird species. With these in mind, a fresh checklist has been prepared.

Materials and Methods

This study has been essentially qualitative. Field trips were undertaken atleast thrice a week customarily in the mornings between 6.30 and 9.30 a.m. and were sometimes supplemented by evening trips. Binoculars of magnifications 8 × 40 and 10 × 50 were used. Special observations, if any, were recorded. Identification of species was facilitated by useful guides. Bird watching was also conducted at night on occasion, with the aid of torches, and when available the headlights of a motor cycle. For identification, Ali and Ripley (1968), Ali (1981) and Woodcock (1983) have been referred.

The abbreviations used for various species on the basis of their occurrence are :

PR	–	Permanent Residents
LM	–	Local Migrants
WM	–	Winter migrants
WV	–	Winter visitors
VC	–	Very Common
C	–	Common
S	–	Sporadic
NC	–	Not Common
R	–	Rare

In order to understand the basis of habitat preference, the Campus has been mapped. Fig.1 provides the general layout of the campus while Fig.2 indicates the relative distribution and abundance of vegetational tracts.

Results and Discussion

The birds observed over the period of study are as listed below :

I Order : Podicipediformes
Family : Podicipitidae : Grebes
1. Little Grebe – *Podiceps ruficollis* (Pallas) LM–NC

II Order : Pelecaniformes
Family : Phalacrocoracidae : Cormorants and Darters
1. Little Cormorant – *Phalacrocorax niger* (Vieillot) WM–NC

III Order : Ciconiiformes
Family : Ardeidae : Herons, Egrets and Bitterns.
1. Pond Heron *Ardeola grayii* (Sykes)
2. Night Neron – *Nycticorax nycticorax* (Linnaeus) PR–C
3. Grey Heron – *Ardea cinerea* (Linnaeus) WM–NC
4. Cattle Egret – *Bubulcus ibis* (Linnaeus) LM–C
5. Little Egret – <lEgretta garzetta (Linnaeus) LM–C

IV Order : Falconiformes
Family : Accipitridae
1. Common Pariah Kite – *Milvus migrans* (Boddaert) LM–C
2. Blackwinged Kite – *Elanus caeruleus* (Desfontaines) LM–C
3. Brahminy Kite – *Haliastur indus* (Boddaert) LM–NC
4. Crested Honey Buzzard – *Pernis ptilorhynmchus ruficollis* (Lesson) LM–NC
5. Shikra – *Accipiter badius* (Gmelin) PR–C
6. Booted Hawk Eagle – *Hieraetus pennatus* (Gmelin) LM–R

V Order : Galliformes
Family : Phasianidae : Partridges, Pheasants, Junglefowl, Quails.
1. Grey Partridge – *Francolinus pondicerianus* (Gmelin) PR–C

VI Order : Gruiformes
Family : Turnicidae : Button and Bustard Quails.
1. Common Bustard Quail – *Turnix susciator* (Gmelin) PR–C
Family : Rallidae : Rails, Coots
1. Whitebrested Waterhen – *Amauromis phoenicurus* (Pennant) WV–NC
2. Watercock or Kora – *Gallicrex cinerea* (Gmelin) LM–R

VII Order : Charadriiformes
Family : Charadriidae
Sub-family : Charadriinae : Plovers
1. Redwattled Lapwing — *Vanellus indicus* (Boddaert) WV–NC
2. Yellowwattled Lapwing — *Vanellus malabaricus* (Boddaert) LM–S
Sub-Family : Scolopacinae : Curlews, Sandpipers, Snipes
1. Wood or Spotted Sandpiper — *Tringa glareola* (Linnaeus) WV–C
2. Fantail snipe – *Gallinago gallinago* (Linnaeus) WV–C

VIII Order Columbiformes
Family : Columbidae : Pigeons, Doves
1. Blue Rock Pigeon – *Columba livea* (Gmelin) LM–R
2. Spotted Dove – *Streptopelia chinensis* (Scopoli) FR–VC
3. Little Brown or Senegal Dove – *Streptopelia senegalensis* (Linnaeus) LM–NC

IX Order : Psittaciformes
Family : Palttacidae : Parrots
1. Roseringed Parakeet – *Psittacula krameri* (Scopoli) PR–C

X Order : Cuculiformes
Family : Cuculidae : Cuckoos
1. Pied Crested Cuckoo – *Clamator jacobinus* (Boddaert) LM–C
2. Common Hawk-cuckoo – *Cuculus varius* (Vahl) LM–C
3. Plaintive Cuckoo – *Cacomantis passerinus* (Vahl) WV–NC
4. Koel – *Eudynamis scolopacea* (Linnaeus) PR–VC
5. Crow-pheasant or Coucal – *Centropus sinensis* (Stephens) PR–C
6. Small Greenbilled Malkoha – *Rhopolytes virdirostris* (Jerdon) PR–NC

XI Order : Stringiformes
Family : Stringidae
Sub-Family : Tytoninae : Barn owls
1. Barn or Screech Owl – *Tyto alba* (Scopoli) PR–NC
2. Indian Great Horned Owl – *Bubo bubo* (Linnaeus) PR–NC
Sub-family : Striginae
1. Spotted Owlet – *Athene brama* (Temminck) PR–C
2. Collard Scops Owl — *Otus bakkamoena* (Pennant) PR–NC

XII Order : Caprimulgiformes
Family : Caprimulgidae: Nightjars
1. Common Indian nightjar – *Caprimulgus asiaticus* (Latham) PR–NC

XIII Order : Apodiformes
Family : Apodidae
Sub-family : Apodinae : Swifts
1. Palm Swift – *Cypsiurus parvus* (Liechtenstein) PR–C

XIV Order : Coraciformae
Family : Alcedinidae : Kingfishers
1. Pied Kingfisher – *Ceryle rudis* (Linnaeus) LM–NC
2. Smallblue Kingfisher – *Alcedo atthis* (Linnaeus) LM–NC
3. Whitebreasted Kingfisher – *Halcyon smyrnensis* (Linnaeus) PR–C
4. Brownheaded Storkbilled Kingfisher – *Pelargopsis capensis* (Linnaeus) LM–R
Family : Meropidae : Bee-eaters
1. Small Green Bee-eater – *Merops orientalis* (Latham) LM–C
2. Bluetailed Bee-eater – *Merops philippinus* (Linnaeus) LM–C
Family : Coraciidae : Rollers
1. Roller or Blue Jay – *Coracias benghalensis* (Linnaeus) PR–C
Family : Upupidae : Hoopoes
1. Hoopoe – *Udupa epops* (Linnaeus) PR–C

XV Order : Piciformes
Family : Capitonidae : Barbets
1. Crimsonbreasted Barbet – *Megalaima haemacephala* (Muller) PR–C
Family : Picidae
1. Goldenbacked Woodpecker – *Dinopium benghalense* (Linnaeus) PR–C

XVI Order : Passeriformes
Family : Pittidae
1. Indian pitta – *Pitta brachyura* (Linnaeus) WV–C

Family : Alaudidae : Larks
1. Redwinged Bush Lark – *Mirafra erythroptera* (Blyth) PR–C
2. Ashycrowned Finch-Lark – *Eremopterix grisea* (Scopoli) LM–NC
Family : Hirundinidae : Swallows
1. Common Swallow – *Hirundo rustica* (Linnaeus) WV–C
2. Redrumped or Straited Swallow – *Hirundo daurica* (Linnaeus) PR–NC
Family : Laniidae – Shrikes
1. Rufousbacked Shrike – *Lanius schach* (Linnaeus) PR–NC
2. Brown Shrike – *Lanius cristatus* (Linnaeus) WV–NC
Family : Oriolidae – Orioles
1. Golden oriole – *Oriolus oriolus* (Linnaeus) LM–C
2. Blackheaded Oriole – *Oriolus xanthornus* (Linnaeus) WV–R
Family : Dicruridae : Drongos
1. Black Drongo– *Dicrurus adsimilis* (Bechstein) PR–C
2. Whitebellied Drongo – *Dicrurus caerulescens* (Linnaeus) WV–NC
Family : Artamidae : Swallow-shrikes
1. Ashy Swallow Shrike – *Artamus fuscus* (Vieillot) PR–NC
Family : Sturnidae : Starlings and Mynas
1. Indian Myna – *Acridotheres tristis* (Linnaeus) PR–VC
2. Brahminy Myna – *Sturnus pagodarum* (Gmelin) LM–C
3. Greyheaded Myna – *Sturnus malabaricus* (Gmelin) LM–NC
4. Rosy Pastor – *Sturnus roseus* (Linnaeus) WV–R
Family : Corvidae – Crows, Pies, Jays
1. House Crow – *Corvus splendens* (Vieillot) PR–VC
2. Jungle Crow – *Corvus macrorhynchos* (Wagler) PR–VC
3. Tree Pie – *Dendrocitta vagabunda* (Latham) PR–C
Family : Campephagidae : Cuckoo-shrikes and Minivets
1. Blackheaded Cuckooshrike – *Coracina melanoptera* (Ruppel) WV–NC
2. Small Minivet – *Pericrocotus cinnamomeus* (Linnaeus) PR–NC
3. Large Cuckoo-Shrike – *Coracina novachollandiae* (Gmelin) LM–NC
4. Common Wood Shrike – *Tephyrodornis pondicerianus* (Gmelin) WV–NC
Family : Irenidae
1. Iora – *Aegithina tiphia* (Linnaeus) PR_C
Family : Pycnonotidae
1. Redvented Bulbul – *Pycnonotus cafer* (Linnaeus) PR–C
2. Redwhiskered Bulbul – *Pycnonotus jacosus* (Linnaeus) PR–C
3. Whitebrowed Bulbul – *Pycnonotus luteolus* (Lesson) PR–VC
Family : Muscicapidae
Sub-Family : Timalinae : Babblers
1. Whiteheaded Babbler – *Turdoides affinis* (Jerdon) PR–VC
2. Rufousbellied Babbler – *Dumetia hyperythra* (Franklin) PR–C
3. Yelloweyed Babbler – *Chrysomma sinense* (Gmelin) LM–C
Sub-family : Muscicapinae
1. Paradise Flycatcher – *Terpsiphone paradisi* (Linnaeus) LM_NC

2. Tickell's Blue Flycatcher - *Muscicapa tickelliae*(Blyth) WV–NC
3. Redbreasted Flycatcher – *Muscicapa parva* (Bechstein) WV–NC
4. Bluethroated Flycatcher –Muscicapa *rubeculoides* (Viyors) WV–NC
5. Brown Flycatcher – *Muscicapa latirostris* (Raffles) WV–NC

Sub-Family : Sylvlinae : Warblers

1. Ashy Wren-Warbler – *Prinia socialis* (Sykes) PR–NC
2. Jungle Wren-Warbler – *Prinia sylvatica* (Jordan) PR–C
3. Streaked Fantail Warbler – *Cisticola juncidis* PR–NC
4. Tailor Bird – *Orthotomus sutorius* (Pennant) PR–C
5. Blyth's Reed Warbler – *Acrocephalus dumetorum* (Blyth) WV–C
6. Dull Greenleaf Warbler – *Phylloscopus trochiloides* WV–C

Sub-Family : Turdinae : Thrushes and Chats

1. Magpie Robin – *Copsychus saularius* (Linnaeus) PR–C
2. Indian Robin – *Saxicoloides fulicata* (Linnaeus) PR–C
3. Orangeheaded Ground Thrush – *Zoothera citriana* (Latham) WV–NC
4. Pied Buschat – *Saxixola caprata* (Linnaeus) PR–NC

Sub-Family : Motacillidae : Pipits and Wagtails

1. Forest Wagtail – *Motacilla indica* (Gmelin) WV–C
2. Large Pied Wagtail – *Motacilla maderaspatenis* (Gmelin) PR–C
3. Paddyfield Pipit – *Anthus novaeseelandiae* (Gmelin) WV–NC

Family : Nectariniidae : Sunbirds

1. Purplerumped Sunbird – *Nectarinia zeylonica* (Linnaeus) PR–VC
2. Purple Sunbird – *Nectarinia asiatica* (Lathem) PR–C
3. Loten's Sunbird – *N. lotenia* (Linnaeus) PR–C

Family : Ploceidae : Weaver birds, Munias, Sparrows

Sub-Family : Ploceinae : Weaver Birds

1. Baya Weaver Bird – *Ploceus philippinus* (Linnaeus) PR–C
2. Whitebacked Munia – *Lonchura striata* (Linnaeus) PR–NC
3. Spotted Munia – *Lonchura punctulata* (Linnaeus) PR–S
4. Blackheaded Munia – *Lonchura malacca* (Linnaeus) PR–NC

Sub-Family : Passerinae : Sparrows

1. House sparrow – *Passer domesticus* (Linnaeus) PR–S

Thus 105 species of birds belonging to 16 orders were recorded. They represent 37 families.

Figure indicates the relative distribution and abundance of vegetational tracts, as mentioned earlier. Behavioural traits is the bottom line for habitat preference. As such, the Spotted Owlet (*Athene brama*) is most commonly found in the exotic, deciduous, avenue patch of *Tabebuia rosea* on the Principal's drive and its surroundings. The Spotted Sandpiper (*Tringa glareola*) is restricted to the paddy fields while the Dabchick (*Podiceps ruficollis*) occurs only in the winter. Alternatively, other bird species like the Koel (*Eudynamis scolopacea*), the Roseringed Parakeet (*Psittacula krameri*) and the Whiteheaded Babbler (*Turdoides affinis*) ubiquitous. Knowledge of such distributions enabled us to make fairly accurate predictions of bird occurrence.

That the area under study is rich in avifaunal distribution is evident from the number of species recorded in each list made of the region (Guindy National Park with a much larger land area of 2.8 sq. miles has relatively fewer species – 123). It is true that to Siromoney (1971)'s list of 149 species have been added species like the Tickell's Blue Flycatcher, the Water cook, the Streaked Fantail Warbler, the Blackheaded Munia and the Tree pie. However, the decrease in the number of species on Campus since the 1971 list indicated that deforestation has definitely influenced bird diversity. Loss of habitat has been a causative reason contributing to he disappearance of many of our feathered friends. This comparison underlines the necessity to preserve and protect what is left of the natural habitat, which in turn will sustain a diverse life.

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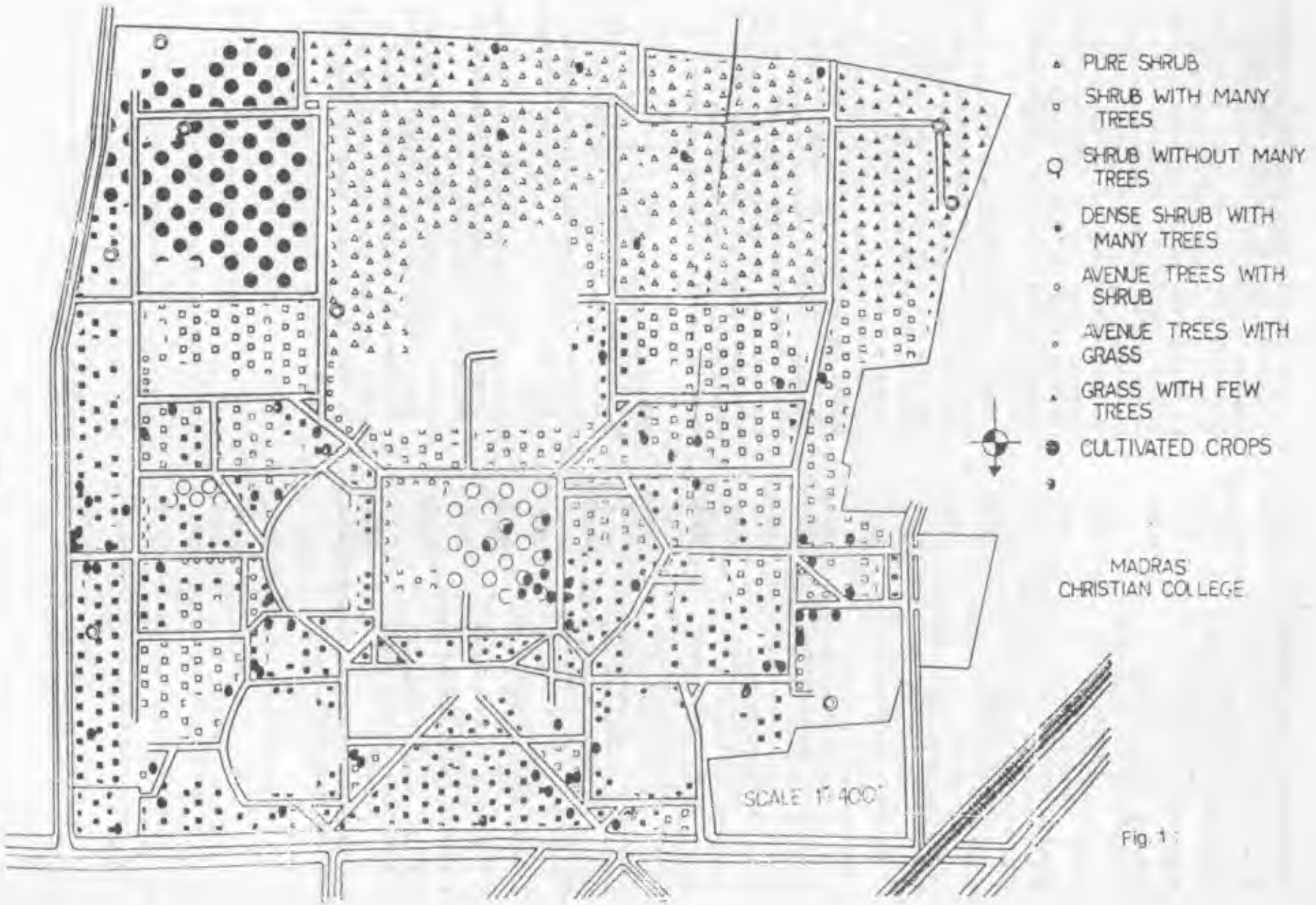
PURE SHRUB
SHRUB WITH MANY TREES
SHRUB WITHOUT MANY TREES
DENSE SHRUB WITH MANY TREES
AVENUE TREES WITH SHRUB
AVENUE TREES WITH GRASS
GRASS WITH FEW TREES
CULTIVATED CROPS
MADRAS CHRISTIAN COLLEGE
SCALE 1" 400'

Fig. 1

Project Bustard : Last Chance to Save the Great Indian Bustard

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Introduction

The Great Indian Bustard, *Ardeotis nigriceps* is one of the rarest birds of the world. It was prevalent in the short grass plains of Uttar Pradesh, north of Tamil Nadu, Sind in Pakistan and in the west of Orissa. Unrestricted shooting and destruction of grasslands exterminated the bustard from most of its range. By the 1980s it survived in small numbers in Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Andhra Pradesh and Karnataka. After the International Conference on Bustards organized in 1980 by Tourism and Wildlife Society of India, based at Jaipur, all these states took conservation steps and eight protected areas were established (Rahmani, 1987, 1989). In the mid 1980s, bustard population was estimated to be between 600 to 1500, with half of the birds surviving in Rajasthan (Rahmani, 1989).

Two extensive surveys in 1993 in the Thar and regular visits to bustard sanctuaries in Madhya Pradesh, Gujarat, Andhra Pradesh and Maharashtra showed that bustard numbers have drastically declined in Madhya Pradesh, Gujarat and Rajasthan while the population was stable in Rollapadu (Andhra Pradesh), and increasing in Nannaj (Maharashtra).

Besides the Great Indian Bustard, three more species of bustards occur in India: the Houbara, *Chlamydotes undulata*; the Lesser Florican, *Sypheotides indica* and the Bengal Florican, *Houbaropsis bengalensis*(Ali & Ripley, 1983). Although, this paper deals mainly with the Great Indian Bustard, conservation of other Indian bustards is also discussed.

Material and Methods

In 1993 first survey of the Thar desert and Kutch was conducted between 2 February to 10 March, and second between 11 July to 31 August. During June-July 1992, Solapur and Ahmednagar districts of Maharashtra and Kutch of Gujarat were surveyed. In addition to these systematic surveys, regular visits were made to Nannaj, Rollapadu, Karera and Ghatigoan. Additional information was gathered from the staff of Grassland Ecology Project posted at Rollapadu, Nannaj and Banni (Kutch) and by contacting personnels of the forest departments.

Results and Discussion

Population estimates of Great Indian Bustard in the 1980s and in 1992-93 are given in Table I.

The results of the present surveys were compared with earlier field studies between 1981 and 1989 (see Rahmani, 1988, 1989; Rahmani and Manakadan, 1990).

Madhya Pradesh

The results showed that the bustard declined all over its range. The greatest decrease was seen in Karera and Ghatigaon bustard sanctuaries which were specially established for the protection of this species. In Madhya Pradesh there were four known bustard areas: Karera, Ghatigaon, Pohri and Panna. In the mid 1980s, the total bustard population in these four areas was estimated to be around 50, with Karera and Ghatigoan having 30- 35 birds, but since the late 1980s there has been a progressive decrease of bustards in these sanctuaries. In Karera, not more than five birds were found. Even territorial males which were seen for many years, and as long as villagers remember, were not seen during the display season in 1993. Condition of Ghatigaon was as bad as Karera. The Forest Range Officer, in charge of bustards at Ghatigaon saw only two birds in six months.

Gujarat

In Gujarat, by 1980s the bustards had become extremely rare and survived only in two districts i.e. Bhatiya in Kalyanpur taluka of Jamnagar, and Abdasa and Mandvi talukas of Kutch. There was stray record from Surendranagar district. Total population in the whole of Gujarat was estimated to be between 20 and 30 bustards. During the last ten years, bustard number declined by almost fifty percent. In 1990, a small bustard sanctuary of 100 ha was established near Lala village where breeding was noted. In the Bhatiya area of Jamnagar district, where the Gujarat Government is planning a bustard sanctuary, five birds were seen in 1983. It is doubtful if the population can recover from such low numbers.

Maharashtra

Nannaj area in Solapur district of Maharashtra has shown the most satisfactory increase in the bustard numbers, mainly because the Forest Department provided good measures to protect its grassland habitat. In 1981, the maximum number seen was only eight. Since then successful breeding has been observed, and by August 1993, there were 37 bustards. This increase was due to successful breeding and immigration from surrounding areas.

Andhra Pradesh

Rollapadu bustard sanctuary in Kurnool district has also shown positive results, thanks to effective protection to the bustard and its grassland habitat, especially during the initial stages of establishment of the sanctuary. Territorial males and successful breeding were sighted every year. However, there appears to be some laxity in protection when the birds go out, hence the increase in the bustard number is not as projected. Reports of bustard shooting by rich vehicle-borne poachers from Hyderabad could be one

of the reasons why the bustard numbers have not further increased. During 1987-88, around 50 bustards were estimated in the Rollapadu grasslands, and the present estimate (in 1993) is also the same.

Karnataka

In Karnataka, bustards are chiefly seen around Rannibennur Blackbuck Sanctuary and Guttal plantation in Dharwad district. However, as the sanctuary itself is not very suitable for bustards due to excessive growth of eucalyptus, the birds are seen outside the sanctuary in grazing land which suffer from over-exploitation.

Rajasthan

During 1980s, more than half of the bustards in India were present in Rajasthan, mainly in the Thar desert (Rahmani, 1989; Rahmani and Manakadan, 1990). in nine districts: Kota, Ajmer, Bhilwara, Jalore, Pali, Bikaner, Jodhpur, Jaiselmer and Barmer (Vardhan & Goriup, 1980). Now, all over the Thar desert, bustard population has drastically declined (see Table I). In some areas, e.g. Diyatra, Bap, Sam, Sudasari, the bustard numbers have halved, or disappeared, e.g. Khuri, Miyajlar.

The bustard is still reported from a large area in the western Thar desert (mainly Jaiselmer district) but in Nachna, Ramgarh, villagers reported bustard poaching by outsiders. Most of these rich poachers hunt for Houbara and Sandgrouse, but also shoot the Great Indian Bustard.

The most surprising decline was seen in Sam-Sudasari areas of the Desert National Park in Jaiselmer, under Forest Department, with better protection than other core areas (e.g. Miyajlar, Khuri, Sotto) of the Park, where the population between in 1986 and 1993, reduced from 25 bustards, to five (Forest Department guards however, claim up to 125 bustards!).

Reasons for decline

1. Destruction of breeding areas

Destruction or alteration of grassland habitat is perphaps the most important reason for the decline of bustards in Madhya Pradesh, Gujarat and Karnataka. Conservation success depends on protection to adult birds and to their breeding areas.

2. Disturbances

There is no bustard area in India which is free from human disturbance. Like grazing, cultivation, and activities linked to increase in human population. Some of these are listed in Table II.

3. Shooting

At Karera, Ghatgaon, Nannaj, etc., poaching of bustards is under control, but shooting appears to be play ing a major role in decimation of bustards of the Thar desert.

All the four species of bustards found in India have the highest legal protection but implementing the law more strigently to eliminate poaching is crucial. The habitats of the bustards are not well protected and this constitutes the biggest threat to bustards. Therefore, our major conservation efforts have to be addressed to habitat protection especially breeding grounds.

Project Bustards

The grasslands and deserts are under-represented in the protected area network in our country. The studies by Rodgers and Panwar (1988), Endangered Species Project and Grassland Ecology Project of the Bombay Natural History Society have identified many potential areas which could be developed as new sanctuaries.

There is a need to have a nationally coordinated conservation project for the Indian bustards and their habitats. Hence a 'Project Bustard' is suggested.

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Table 1 : Population Estimates of Bustard in the 1980s and 1992-93

State	Area	Earlier numbers	In 1992/93
Madya Pradesh	Karera,	20-25 (1983 -86)	4-5 (1993)
	Ghatigaon	12-15 (1983 -85)	3-5 (1993)
	Phori	10 -15 (1983-84)	Not surveyed but few still survive
	Panna	5 -10 (in 1988)	Not surveyed
Gujarat	Bhatiya	5 seen (1984)	None seen in 1993 but still survives
	Lala	1 seen (1984)	5 in 1981
Maharashtra	Nannaj	10 -13 (1981)	40 - 45 in 1991
	Karmala	8 (1981-82)	None
	Kamuni	5 - 8 (1981 -84)	3 in 1992
Andra pradesh	Rollapadu	50 (1987 - 88)	50 (1992 -93)
Karnataka	Rannibennur	5 -10 (1984 -85)	5 -6 (1991)
Rajasthan	Sorsan	8 - 10 (1984 -86)	8 - 10 (1991 -92)
	Sonkhaliya	30 seen in 1986	None in 1993*
	Diyatra	13 in 1986	4 in Feb. 1993 None in July 1993
	Bap	11 in 1983	6 in Feb 1993 None in July 1993
	Sam-sudasari	25 - 30 in 1986	5 in Feb 1993 15 in July 1993
	Khuri	14 in 1986	None in 1993
	Miyajlar	5 in 1986 **	None

* Upto 90 reported by the Forest Department

** Reported by the Forest Department

Table 2 : Specific disturbances to Bustard Santuries / Areas

Name	Type of Disturbance	Migratory measures
Karera	Construction of canal	None
Ghatigaon	Construction of railway line and canal	None
Pohri	Construction of gas pipeline	Compensation
Nannaj	Plan of a Spinning Mill	Plan cancelled
DNP	Construction of a canal	None
Lala	Prosopis plantation	Plantation stopped

Factors Affecting Waterbirds in Chikmagalur

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Introduction

In May, the Fisheries Department leases out tanks around Chikmagalur for fishing. The impact of fishing on birds is reported in this paper.

Material and Methods

To study the impact of fishing on birds, observations were recorded at monthly intervals from October '92 to April '93 with a pair of 7 ± 50 and 8 ± 30 binoculars. Birds were categorized into : viz., Waterfowl, Waders, Surface- water Foragers and Scavengers. Although observations were recorded on several tanks, detailed observations were confined to the 8 tanks.

Results and Discussion

From October to January observations were designated as 'before fishing' and from February to May as 'after fishing'. Not all increase or decrease or changes in bird species composition and numbers could be ascribed to fishing However, in some cases of birds the changes were clear and could be ascribed to fishing operation alone. Only such cases are dealt with here. For instance, the size of nesting territory of Pheasant-tailed Jacana as a result of the fishing activity in other tanks.

Thus 20 species of waterfowl, 4 of Waders and 2 of surface-water foragers were recorded between October-January, i.e. before fishing. After fishing only 5 species of scavengers were observed in all the 8 tanks. An estimated average number of birds (n=8) recorded before fishing was 294 (mean of 4 observations) per tank compared to four (only scavengers) after fishing.

It may be noted that Painted Stork and Spoonbill recorded in tanks of Chikmagalur are the two species considered endangered in India (Sridhar and Srinivasa, 1992).

Fishing depleted the waterfowl food and affected plantlife,surface-water foraging, and nesting of resident species. Piscivorous species like cormorants abandoned the tanks.

The changes that are taking place in freshwater tanks are undoubtedly increasing the area of conflict between birds and men. Certainly there is a need to regulate fishing and leave some tanks for waterfowl alone.

Chakravarthy and Tejasvi (1993) have recorded a total of 59 species of water birds in freshwater tanks in this region. Planting of trees in the watershed areas, desilting and creation of perch and nesting sites in certain tanks and maintenance of shallow water zone and share space would help sustain waterbirds in and around Chickmagalur town.

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Checklist of Birds of Shimoga and Gudavi

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**"INCHARA", Chitpadi, Udipi

Family : PODICIPEDIDAE		
001	Little Grebe	Podiceps ruficollis
Family : PHALACROCORACIDAE		
002	Cormorant	Phalacrocorax carbo
003	Indian Shag	Phalacrocorax fuscicollis
004	Little Cormorant	Phalacrocorax niger
005	Darter	Anhinga rufa
Family : ARDEIDAE		
006	Grey Heron	Ardea cinerea
007	Purple Heron	Ardea purpurea
008	Pond Heron	Ardeola grayii
009	Cattle Egret	Bubulcus ibis
010	Smaller Egret	Egretta intermedia
011	Large Egret	Ardea alba
012	Little Egret	Egretta garzetta
013	Night Heron	Nycticorax nycticorax
014	Chestnut Bittern	Ixobrychus cinnamomeus
015	Yellow Bittern	Ixobrychus sinensis
016	Black Bittern	Ixobrychus flavicollis
Family : CICONIIDAE		
017	Openbill Stork	Anastomus oscitans
018	Whitenecked Stork	Ciconia episcopus
Family : THRESKIORNITHIDAE		
019	White Ibis	Threskiornis aethiopica
020	Black Ibis	Pseudibis papillosa
021	Spoonbill	Platalea leucorodia
Family : ANATIDAE		
022	Lesser Whistling Teal	Dendrocygna javanica
023	Pintail	Anas acuta
024	Common Teal	Anas crecca
	Spotbilled Duck	Anas poecilorhyncha
026	Garganey	Anas querquedula
027	Cotton Teal	Nettapus coromandelianus
028	Comb Duck	Sarkidiornis melanotos
Family : ACCIPITRIDAE		
029	Blackwinged Kite	Elanus caeruleus
030	Blyth's Baza	Aviceda jerdoni
031	Honey Buzzard	Pernis ptilorhyncus
032	Pariah Kite	Milvus migrans
033	Brahminy Kite	Haliastus indus
034	Shikra	Accipeter badius
035	Lesser Spotted Eagle	Aquila pomarina
036	Whitebacked Vulture	Gyps bengalensis
037	Pale Harrier	Circus macrourus
038	Marsh Harrier	Circus aeruginosis
039	Scavenger Vulture	Neophron percnopterus
040	Crested Serpent Eagle	Spilornis cheela
Family : FALCONIDAE		
041	Kestrel	Falco tinnunculus
Family : PHASIANIDAE		
042	Grey Partridge	Francolinus pondicerianus
043	Grey Jungle Fowl	Gallus sonneratii
044	Common Peafowl	Pavo cristatus
Family : Rallidae		
045	Little Crake	Porzena parva
046	Baillon's Crake	Porzana pusilla
047	Ruddy Crake	Porzana fusca
048	Whitebreasted Waterhen	Amaurornis phoenicurnus
049	Moorhen	Gallinula chloropus
050	Purple Moorhen	Porphyrio porphyrio
051	Coot	Fulica atra
Family : JACANIDAE		
052	Pheasanttailed Jacana	Hydrophasianus chirurgus
053	Bronzewinged Jacana	Metopidius indicus
Family : ROSTRATULIDAE		
054	Painted Snipe	Rostratula benghalensis
Family : Recurvirostridae		
055	Blackwinged Stilt	Himantopus himantopus
Family :		
056	Indian Courser	Cursorius coromandelicus
057	Small Pranticole	Glareola lactea
Family : CHARADRIIDAE		
059	Redwattled Lapwing	Venellus indicus
059	Yellowwattled Lapwing	Vanellus malabaricus
060	Little Ringed Plover	Charadrius dubius
061	Green Sandpiper	Tringa ochropus
062	Wood Sandpiper	Tringa glareola
063	Common Sandpiper	Tringa hypoleucos
064	Sanderling	Calidris alba
065	Little Stint	Calidris minutus
Family : LARIDAE		
066	Whiskered Tern	Chlidonias hybrida
067	Indian River Tern	Sterna aurantia
068	Common Tern	Sterna hirunda

Family : COLUMBIDAE

069	Pompadour	Treron pompadora
070	Yellowlegged Green Pigeon	Treron phoenicoptera
071	Blue Rock Pigeon	Columba livia
072	Turtle Dove	Streptopelia tranquelarica
073	Pied Imperial Pigeon	Ducula bicolor
074	Green Imperial Pigeon	Ducula aenea
075	Rufous Turtle Dove	Streptopelia orientalis
076	Spotted Dove	Streptopelia chinensis
077	Emerald Dove	Chalcophaps indica

Family : PSITTACIDAE

078	Roseringed Parakeet	Psittacula krameri
079	Blossomheaded Parakeet	Psittacula cyanocephhala
080	Bluewinged Parakeet	Psittacula columboides
081	Indian Lorikeet	Loriculus vernalis

Family : CUCULIDAE

082	Piedcrested Cucoo	Clamator jacobinus
083	Brain Fever Bird	Cuculus varius
084	Cuckoo	Cuculus canorus
085	Indian Plaintive Cuckoo	Cacomantis merulinus
086	Koel	Eudynamys scolopacea
087	Sirkeer Cuckoo	Taccocua leschenaulti
088	Coucal	Centropus sinensis

Family : STRIGIDAE

089	Barn Owl	Tyto alba
090	Spotted Owlet	Anthene bramna

Family : PODARGIDAE

091	Ceylon Frogmouth	Batrachostomus monilinger

Family : CAPRIMULGIDAE

092	Common Nightjar	Caprimulgus asiaticus

Family : APODIDAE

093	Alpine Swift	Apus melba
094	House Swift	Cypsirus parvus
096	Crested Tree Swift	Hemiprocne longipennis

Family : ALCEDINIDAE

097	Lesser Pied Kingfisher	Ceryle rudis
098	Common Kingfisher	Alcedo atthis
099	Storkbilled Kingfisher	Pelargopsis capensis
100	White- breasted Kingfisher	Halcyon amyrnensis

Family : MEROPIDAE

101	Chestnutheaded Bee-eater	Merops leschenautti
102	Bluetailed Bee-eater	Merops philippinus
103	Green Bee-eater	Merops Orientalis

Family : CORACIIDAE

104	Indian Roller	Coracias benghalensis

Family : UPUPIDAE

105	Hoopoe	Udupa epops

Family : BUCEROTIDAE

106	Common Grey Hornbill	Tockus birostris
107	Malbar Grey Hornbill	
108	Malbar Pied Hornbill	
108	Malbar Pied Hornbill	Anthracoceros coronatus

Family : CAPITONIDAE

109	Large Green Barbet	Megalaima zeylanica
110	Small Green Barbet	Megalaima viridis
111	Crimsonthroated Barbet	Megalaima rubricapilla
112	Coppersmith	Megalaima haemacephala

Family : PICIDAE

113	Rufous woodpecker	Micropternus brachyurus
114	Lesser Goldenbacked Woodpecker	Dinopium benghalense
115	Great Black Woodpecker	Drycopus javensis
116	Mahratta's Woodpecker	Picoides mahrattensis
117	Heartspotted Woodpecker	Hemicircus canente
118	Blackbacked Woodpecker	Chrysocolapte festivus
119	Larger Goldenbacked Woodpecker	Chrysocolaptes lucidus

Family : PITTIDAE

120	Indian Pitta	Pitta brachyura

Family : ALAUDIDAE

121	Blackcrowned Finchlark	Eremopterix nigriceps
122	Malabar Crested Lark	Galerida malabarica

Family : HIRUNDINIDAE

123	Dusky Crag Martin	Hirundo concolor
124	Swallow	Hirundo rustica
125	House Swallow	Hirundo tahitica
126	Wiretailed Swallow	Hirundo smithii
127	Indian Cliff Swallow	Hirundo fluvicola
128	Redrumped Swallow	Hirundo gaurica

Family : LANIIDAE

129	Grey Shrike	Lanius excubitor
130	Rufous Backed Shrike	Lanius schach
131	Brown Shrike	Lanius cristatus

Family : ORIOLIDAE

132	Golden Oriole	Oriolus oriolus
133	Blackheaded Oriole	Oriolus xanthornus

Family : DICRURIDAE

134	Black drongo	Dicrurus adsimilis
135	Whitebellied Drongo	Dicrurus caerulescens
136	Bronzed Drongo	Dicrurus aeneus
137	Racket-tailed Drongo	Dicrurus paradiseus

Family: ARTAMIDAE

138	Ashy Swallow Shrike	Artamus fuscus

Family: STURNIDAE

139	Greyheaded Myna	Sturnus malabaricus
140	Brahminy Myna	Sturnus pagodarum
141	Rosy Pastor	Sturnus roseus
142	Common Myna	Acridotheres tristis
143	Jungle Myna	Acridotheres fuscus
144	Hill Myna	Gracula religiosa

Family : CORVIDAE

145	Indian Tree Pie	Dendrocitta vagabunda
146	White Bellied Tree Pie	Dendrocitta leucogastra
147	House Crow	Corvus splendens
148	Jungle Crow	Corvus macrohynchos

Family : CAMPEPHAGIDAE

149	Common Wood Shrike	Tephrodornis pondicerianus
150	Large Cuckoo Shrike	Coracina novaehollandiae
151	Black Headed Cuckoo Shrike	Coracina melanoptera
152	Scarlet Minivet	Pericrocotus flammeus
153	Small Minivet	Pericrocotus cinnamomeus

Family : IRENIDAE

154	Common Iora	Aegithina tiphia
155	Gold Fronted Chloropsis	Chloropsis aurifrons
156	Goldmantled Chloropsis	Chloropsis cochinchinensis
157	Fairy Blue Bird	Irena puella

Family : PYCNONOTIDAE

158	Rubythroated Bulbul	Pycnonotus melanicterus
159	Redwhiskered Bulbul	Pycnonotus jocosus
160	Red Vented Bulbul	Pycnonotus cafer
161	White Browed Bulbul	Pycnonotus luteolus
162	Yellow Browed Bulbul	Hypsipetes indicus
163	Black Bulbul	Hypsipetes madagascariensis

Family : MUSCICAPIDAE (Sub Family : TIMALINAE)

164	Slatyheaded Scimitar Babbler	Pomatorhinus reeficollis
165	Blackheaded Babbler	Rhopocichla atriceps
166	Yelloweyed Babbler	Chrysomma sinense
167	Common Babbler	Turdoides caudatus
168	Large Grey Babbler	Turdoides malcolmi
169	Rufous Babbler	Turdoides subrufus
170	Jungle Babbler	Turdoides striatus
171	Quaker Babbler	Alcippe Poioicephala

Sub Family: MUSCICAPINAE

172	Redbreasted Flycatcher	Muscicapa parva
173	Whitebellied Blue Flycatcher	Muscicapa pallipes
174	Tickell's Blue Flycatcher	Muscicapa tickelliae
175	Nilgiri Flycatcher	Muscicapa albicaudata
176	Grey Headed Flycatcher	Culicicapa ceylonensis
177	Whitethroated Tantail White Spotted Flycatcher	Rhipidura albogularis
178	Paradise Flycatcher	Terpsiphone paradisi
179	Blacknaped Flycatcher	Hypothymis azurea

Sub Family: SYLVIINAE

180	Streaked Fantail Warbler	Cisticola juncidis
181	Plain Wren-Warbler	Prinia subflava
182	Jungle Wren-Warbler	Prinia sylvatica
183	Ashy Wren-Warbler	Prinia socialis
184	Tailor Bird	Orthotomus sutorius
185	Grasshopper Warbler	Locustella naevia
186	Great Reed Warbler	Acrocephalus stentoreus
187	Blyth's Reed Warbler	Acrocephalus dumetorum
188	Chiffchaff	Phylloscopus collybita
189	Plain Leaf Warbler	Phylloscopus inornatus

Sub Family : TURDINAE

190	Magpie Robin	Copsychus saularis
191	Shama	Copsychus malabaricus
192	Pied Bush Chat	Saxicola caprata
193	Indian Robin	Saxicoloides fulicata
194	Blueheaded Rock Thrush	Monticola cinclorhynchus
195	Orangeheaded Ground Thrush	Zoothera citrina

Family : PARIDAE

196	Grey Tit	Parus major
197	Yellowcheeked Tit	Parus xanthogenys

Family : SITTIDAE

198	Chestnutbellied Nuthatch	Sitta castanea
199	Velvetfronted Nuthatch	Sitta frontalis

Family : MOTACILLIDAE

200	Tawny Pipit	Anthus campestris
201	Paddy Field Pipit	Anthus navaeselandiae
202	Nilgiri Pipit	Anthus nilghiriensis
203	Forest Wagtail	Motacilla indica
204	Yellow Wagtail	Motacilla flava
205	Yellowheaded Wagtail	Motacilla citreola
206	Grey Wagtail	Motacilla caspica
207	Pied Wagtail	Motacilla alba
208	Large Pied Wagtail	Motacilla maderaspatensis

Family : DICAEIDAE

209	Tickell's Flowerpecker	Dicaeum erythrohynchos

Family : NECTARINIIDAE

210	Purplerumped Sunbird	Nectarinia zeylonica
211	Small Sunbird	Nectarinia minima
212	Loten's Sunbird	Nectarinia lotenia
213	Purple Sunbird	Nectarinia asiatica

214	Yellowbacked Sunbird	Aethopyga siparaja
215	Little Spider Hunter	Arachnothera longirostris

Family: ZOSTEROPIDAE

216	White-Eye	Zosterops palperbrosa

Family : PLOCEIDAE

Sub family : PASSERINAE

217	House Sparrow	Passer domesticus

Sub Family : PLOCEINAE

218	Baya	Ploceus philippinus
219	Streaked Weaver	Ploceus manyar

Sub Family : Estridinae

220	Avadavat	Estrilda amandava
221	Whitethroated Munia	Lonchura malabarica
222	Whitebacked Munia	Lonchura striata
223	Spotted Munia	Lonchura punctulata
224	Blackheaded Munia	Lonchura malacca

Family : PHASIANIDAE

225	Bed Spur Fowl	Galloperidix lunulata

BIRDS OF GUDAVI : By V. Raghunatha

Family : ANATIDAE

226	Wigeon	Anas penelope
227	Shoveller	Anas clypeata

Family : ACCIPITRIDAE

228	Crested Hawk Eagle	Spizaetus cirrhatus
229	Greyheaded Fishing Eagle	Ichythyophaga ichthyaetus
230	Indian Longbilled Vulture	Gyps indicus
231	Montagu's Harrier	Circus pygargus

Family : PHASIANIDAE

232	Painted Partridge	Francolinus pictus

Family : TURNICIDAE

233	Bustard Quail	Turnix suscitator

Family : RALLIDAE

234	Banded Crake	Rallina eurizonoides

Family : CHARADRIIDAE

235	Golden Plover	Pluvialis dominica
236	Green Shank	Tringa nebularia
237	Fantail Snipe	Gallinago gallinago

Family: LARIDAE

238	Blackbellied Tern	Sterna acuticauda

Family: COLUMBIDAE

239	Imperial Pigeon	Ducula badia

Family : PSITTACIDAE

240	Alexandrine Parakeet	Psittacula euptria

Family : CUCULIDAE

241	Indian Cuckoo	Cuculus micropterus
242	Small Green Billed Malkoha	Rhopodytes viridirostris

Family : STRIGIDAE

243	Mottled Wood Owl	Stris ocellata
244	Brown Wood Owl	Strix leptogrammica

Family : APODIDAE

245	Whiterumped Swift	Apus pacificus

Family : PICIDAE

	Little Scalybellied Green Woodpecker	Picus myrmecophoneus

Family: ALAUDIDAE

	Redwinged Bushlark	Mirafra erythroptera
248	Ashycrowned Finchlark	Eremopterix grisea

Family : MUSCICAPIDAE

249	Franklin's Wrenwarbler	Prinia hodsonii
250	Dull Green Leaf Warbler	Phyllescopus trochiloides
251	Black Red Start	Phoenicurus ochruros
252	Malbar Whistling Thrush	Myiophonus horsfieldii
253	White Throated Ground Thrush	Zoothera citrina
254	Black Bird	Turdus merula

Family : DICAEIDAE

255	Thickbilled Flower Pecker	Dicaeum agile
256	Whiteheaded Babbler	Turdoides affinis

Acknowledgement

We are grateful to Mr K.V. Chandrakantha and Miss K.V. Suma who helped in valuable guidance and corrections.

Checklist of Birds Around Damoh Town, Madhya Pradesh

A. KHER* and P. KHARE**

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Damoh town is in the north-west of Madhya Pradesh. It is between 23°30' and 24°15' north latitude and from 79°15' east to 79°45' east longitude. Damoh is 341 feet above sea level and the average annual rainfall is 1133 mm. As no previous ornithological study had been reported from this region, the present work has been undertaken with a view to explore the avifauna of Damoh.

The study was initiated in October 1992. Tanks, ponds, river banks and forests were surveyed. Seventy eight bird species sighted are listed in the checklist. This list is not complete for two reasons: Firstly, one year is yet to be completed from the date the study started; Secondly, there may be several other species which may not have been seen till date. In the checklist, first 30 species are very common. Approximately 30 species are water-birds including Painted Stork, Spoonbill, Openbilled Stork, Blacknecked Stork, White Ibis and River Tern. A single Spurwinged Plover (*Vanellus spinosus*) and a pair of Great Stone Plover (*Esacus magnirostris*) were sighted once in dry environs.

Checklist Of Birds Around Damoh Town

1. House Sparrow, *Passer domesticus*
2. Jungle Crow, *Corvus macrorhynchos*
3. House Crow, *Corvus splendens*
4. Indian Myna, *Acridotheres tristis*
5. Pied Myna, *Sturnus contra*
6. Brahminy Myna, *Sturnus pagodarum*
7. House Swift, *Apus affinis*
8. Redrumped Swallow, *Hirundo daurica*
9. Dusky Crag Martin, *Hirundo concolor*
10. Common Pariah Kite, *Milvus migrans*
11. White Scavenger Vulture, *Neophron percnopterus*
12. Bengal Vulture, *Gyps bengalensis*
13. Roseringed Parakeet, *Psittacula krameri*
14. Blossom headed Parakeet, *Psittacula cyanocephala*
15. Small Green Bee-eater, *Merops orientalis*
16. Redvented Bulbul, *Pycnonotus cafer*
17. Black Drongo, *Dicrurus adsimilis*
18. Redwattled Lapwing, *Vanellus indicus*
19. Common Babbler, *Turdoides caudatus*
20. Spotted Dove, *Streptopelia chinensis*
21. Ring Dove, *Streptopelia decaocto*
22. Rufousbacked Shrike, *Lanius schach*
23. Indian Robin, *Saxicoloides fulicata*
24. Blue Rock Pigeon, *Columba livia*
25. Hoopoe, *Upupa epops*
26. Roller *Coracias benghalensis*
27. Cattle Egret, *Bulbulcus ibis*
28. Large Egret, *Egretta alba*
29. Median Egret, *Egretta intermedia*
30. Pond Heron, *Ardeola grayii*
31. Magpie-Robin, *Copsychus saularis*
32. Large Cormorant, *Phalacrocorax carbo*
33. Indian Shag, *Phalacrocorax fuscicollis*
34. Grey Heron, *Ardea cinerea*
35. Whitenecked Stork, *Ciconia episcopus*
36. Black Ibis, *Pseudibis papillosa*
37. White Ibis, *Threskiornis aethiopics*
38. Dabchick, *Podiceps ruficollis*
39. Redcrested Pochard, *Netta rufina*
40. Sarus Crane, *Grus antigone*
41. Indian Moorhan, *Gallinula chloropus*
42. Whitebreasted Waterhen, *Amaurornis phoenicurus*
43. Pheasant-tailed Jacana, *Hydrophasianus chirurgus*
44. Bronzewinged Jacana, *Metopidius indicus*
45. Blackwinged Stilt, *Himantopus himantopus*
46. Pied Kingfisher, *Ceryle rudis*
47. Small Blue Kingfisher, *Alcedo atthis*
48. Spoonbill, *Platalea leucorodia*
49. Painted Stork, *Mycteria leucocephala*
50. Openbilled Stork, *Anastomus oscitans*
51. Blacknecked Stork, *Xenorhynchus asiaticus*
52. Cotton Teal, *Nettapus coromandelianus*
53. Purple Moorhen, *Porphyrio porphyrio*
54. Coot, *Fulica atra*
55. River Tern, *Sterna aurantia*
56. Whitebreasted Kingfisher, *Halcyon smyrnensis*
57. Yellow-wattled Lapwing, *Vanellus malabaricus*
58. Blackwinged Kite, *Elanus caeruleus*
59. Brahminy Kite, *Haliastur indus*
60. Shikra, *Accipiter badius*
61. Common Peafowl, *Pavo cristatus*
62. Koel, *Eudynamys scolopacea*
63. Crow-Pheasant, *Centropus sinensis*
64. Coppersmith, *Megalaima haemacephala*
65. Common Grey Hornbill, *Torkus birostris*
66. Mahratta Woodpecker, *Picoides mahrattensis*
67. Wiretailed Swallow, *Hirundo smithii*
68. Golden Oriole, *Oriolus oriolus*
69. Tree Pie, *Dendrocitta vagabunda*
70. Large Cuckoo-Shrike, *Coracina novaehollandiae*
71. Blue Rock Thrush, *Monticola solitarius*
72. Redstart, *Phoenicurus ochruros*
73. White Wagtail, *Motacilla alba*
74. Purple Sunbird, *Nectarinia asiatica*
75. Blackbellied Finch-Lark, *Eremopterix grisea*
76. Rufoustailed Finch-Lark, *Ammomanes phoenicurus*
77. Whitethroated Munia, *Lonchura malabarica*
78. Red Munia, *Estrilda amandava*

Distribution and Habitat Preferences of Pheasants in Forests of Garhwal Himalaya

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Extensive and Intensive studies on pheasants at different altitudes in different forest types of Garhwal Himalaya indicated five endemic pheasant species. Among them Monal *(Lophophorus impejanus* 2700-3500m) Koklas *(Pucrasia macrolopha* 2300-2800m) and Ghir (*Catreus wallichii*1500-1800m) are restricted in distribution with limited tolerance to environmental factors while Kaleej (*Lophura leucomelana*, 400-2300m) and Red Jungle fowl (*Gallus gallus*, 400-1200m) are widespread in distribution.

Our data on sighting frequency indicated that Koklas which is not enlisted as an endangered species in the IUCN red data book and Indian wildlife protection Act-72/80 appears to be as endangered as Monal (less than Chir in our area).

The Monal Pheasant was found to inhabit three types of habitats (temperate evergreen (TEG), subalpine and alpine) dividing its time along these habitats on daily and annual scale. Alpine and subalpine habitasts constitute the summer habitat and TEG the winter. The pheasant prefers *Rhododendrone* shrubs and dense grasses of *Ringal-Koklas prefers TEG, temperate moist (TM) and temperate mixed deciduous (TMD) habitat types & shares TMD with Kaleej. Chir was the least sighted pheasant and prefers open grassy rocky terrain and chirpine habitat types. Kaleej was observed in almost all habitat types from subtrophical to temperate excepting the pine pure forest tyes.*

Intensive observations on Whitecrested Kaleej (*Lophura leucomelana leucomelana*) in subtropical habitat type indicated that maximum sightings for Kaleej were made in subtropical mixed deciduous (STMD) habitat (63.24+6.09%) individual/sighting). In crop fields (CF) 28.35+7.8% ind/sight., in subtropical open scrub (STOS) 18.98+5.28%ind./sight., in subtropical mixed pine (STPP) individual were not sighted. STMD was used by the pheasant for breeding, feeding roosting & for shelter purposes while CF was only used for feeding purposes. *Carrissa sp., Murrayya sp.Rhus sp.* are the most favored shrubs for breeding cover and feeding purposes. This type of information are prerequisite for the development of management plans & for management of Kaleej pheasant.

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Vanishing Migratory Birds of Kawar Lake (Begusarai), Bihar : Conservation and Management

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Introduction

Many limnological studies have been made in India (Das and Srivastava, 1956; Michael, 1969; Munawar, 1970; Bhatnagar and Sharma, 1979; Rai and Dutta Munshi, 1979; Prakash *et al.*, 1983; and Singh, 1986), but no comprehensive information is available on the ecological niche favourable to birds population and its conservation and management except Ali, 1945; Ali & Futehally, 1967; Ali & Ripley, 1983; Ripley, 1982; Vijayan, 1986, Mukherjee, 1969 and Gountlett, 1971.

Material And Methods

Study area

Kawar lake (Begusarai), Bihar is situated at 25° 80' NL and 87° 40' EL at an altitude of 166 m (Das, 1989). Its importance as wetland habitat was realised recently and was declared "Bird Sanctuary" in 1987 by the Government of Bihar under section 37 of the Wild Life Protection Act, 1972. The Department and Ministry of Environment, Forest & Wild Life, Government of India, New Delhi, has also selected and identified this lake as one of the sixteen lakes (wetlands) for its conservation and management. This is an ox-bow lake formed by the meandering action of the channel of the river Burhi Gandak, a tributary of the river Ganga (Fig.1).

The lake's morphometry and physico-chemical characteristics were studied using standard methods (APHA, 1989; Adoni *et al.*, 1985 and Trivedy & Goel, 1984). Bird habit, habitat, number and seasonality were studied by regular visits to the lake as suggested by Das (1990).

Results and Discussion

Physico-chemical Characteristics

The physico-chemical complexes operating in the Kawar lake established its eutrophic character. The eutrophication process is slow, but progressively may lead to terrestrialisation. The annual average physico-chemical characteristics observed have been shown in Table 1.

The physico-chemical and biological diversitic parameters of the lake are the major regulatory force in determining the population density of the birds.

Forty eight (22 + 26) species of migratory and residential birds, respectively, have been found associated with Kawar Lake. Out of them Ciconiformes, Pelicaniformes and Passeriformes contributed substantially to the bird population of the lake throughout the year. The Anseriformes and Charadriformes were the main migratory birds orders which foraged here during the winter. These have given in Tables 2 and 3.

Bird Migration in Kawar Lake

The bird migration has been categorised into (1) winter migrants (2) summer migrants and (3) passage migrants.

Birds visiting the lake between November and February are the winter visitors. Some residential and migratory birds breed or remain in the lake in summer and are called summer visitors. Some pass through Kawar lake in November and are called passage migrants.

The Kawar lake acts as resting place for winter migrants such as cormorants, spoonbill, harrier, osprey, falcon, waders, shrikes, warblers, wagtails and other resident birds such as spotbill teals, ducks and 16 other species including the rare Falcated Teal from Manchuria.

The Falcated Teal (*Anas falcata*) are scarce in number. However, they are found in small groups of 4 to 8 along the lakes and wetlands of North Bihar including Kawar lake in March. There are 6 types of terns and 5 types of gulls including the rare Pink Slenderbilled Gull. Among warblers, there is the uncommon Smoky Leaf-warbler and Eastern Grasshopper Warbler. In the spring, the Kawar lake, other wetlands of North Bihar and Koshi Barrage areas are the major routes of the migratory birds.

The dabchick, cormorant, kingfisher and herons are the resident birds.

The skimmers, terns and gulls are winter visitors to Kawar lake and Kashi barrage. The common Blackheaded Laughing Gull, *Larus ridibundus* and the Yellowlegged Herring, *Larrus argentatus* are familiar here. The Blackbellied Tern, *Sterna melanogaster* is associated with these lakes, swamps, tals, chaurs and reservoirs. The Little Cormorant, *Phalacrocorax niger* reproduce during monsoon in the freshwater lakes, ponds and swamps of North Bihar. The Darter, *Anhinga melanogaster* is a freshwater bird found frequently in the lakes and swamps of North Bihar.

Suggestions

Many species have disappeared from the Kawar lake and adjoining wetlands of North Bihar. Several of these birds were reported by Hodgson (1946).

For conservation, management and protection of the birds of Kawar lake areas should be surveyed and species composition, diversity, abundance and distribution of birds and other biota must be recorded. Physico-chemical factors should be obtained regularly. The lake and its adjoining areas should be protected by fencing. The areas of regular fishing should be fixed. Encroachment of the lake should be stopped. The aquatic weeds must be controlled.

A portion of the lake needs to be declared a protected area and human exploitation should be stopped (Table 4).

After careful observation and analysis, it has been found that the vanishing and extinction of the migratory birds fauna from the Kawar lake and mainly due to the following :

Sudden climatic change
New diseases
Reduced breeding potential
Human interferences
Habitat change
Poaching, hunting, catching and killing
Agricultural exploitation of the lake and its adjoining areas
Commercial and recreational exploitation of the lake
Reclamation and encroachment of the lake for Governments planning
Lack of proper legislation and administrative lapses
Lack of proper environmental education and training of the people.

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Table 1 : The range of different physico-chemical parameters of the Kawar Lake (Bequsarai), from October 1991 to November 1992

Parameters	Minimum	Maximum
Depth (cm)	13.3	347.3
Transparency (cm)	12.5	240.4
Atm. Temp. (°C)	20.4	33.0
Water Temp. (°C)	18.0	31.0
pH	5.0	7.5
Conductivity (m mho)	140.0	730.00
DO_2 (mg/L)	1.20	8.00
FCO_2 (mg/L)	0.00	10.40
Carb. Alk. (mg/L)	0.00	37.60
Bicarb. Alk. (mg/L)	72.80	295.00
Total Hardness (mg/L)	62.00	182.00
Calcium Hardness (mg/L)	43.00	120.20
Magnesium Hardness (mg/L)	15.40	96.00
Calcium (mg/L)	17.28	45.96
Magnesium (mg/L)	3.75	23.42
Chloride (mg/L)	6.40	32.00
Silicate (mg/L)	6.84	35.71
Sodium (mg/L)	16.80	55.76
Potassium (mg/L)	1.23	3.15
Nitrate (mg/L)	0.30	1.38
Phosphate (mg/L)	0.00	0.035
Soil	Sandy Loam with rich humus, fertile, suitable for luxuriant eutrophication.	
Water source	Rains between July to September every year. During flood it gets water also from Burhi Gandak.	
Transparency	January to July transparent water and we can see the forest-like macrophytic structure.	

Table 2 : List of Migratory Birds in and around Karwar Lake (Begusarai)

	Genus Species	Common Local Name
1	Platalea leucoroidea	Spoonbill or Khurpiadabill
2	Anser anser	Greylag Goose (Kaj)
3	Anser indicus	Barheaded Goose
4	Anas acuta	Pintail (Dighaunch)
5	Anas poecilorhyncha	Spotbill Duck or Grey Duck (Kapila)
6	Anas creca	Common Teal (Kerri)
7	Anas strepera	Gadwall (Malkai)
8	Anas querquedula	Garganey (Khaira)
9	Nett a rufina	Redcrested Pochard (Lalsar)
10	Fulica atra	Coot (Sarair)
11	Gallinago stonura	Pintail Snipe
12	Gallinago gallinago	Pintail Common Snipe (Chaha)
13	Gallinago minime	Jack Snipe
14	Ardea cinerea	Grey Heron
15	Anthropodes virgo	Demoiselle Crane
16	Tandorna ferruginea	Ruddy Shelduck or Brahminy Duck
17	Circus macrourus	Pale Harrier
18	Pluvialis dominika	Golden Plover
19	Cuculus micropterus	Indian Cuckoo
20	Cuculus poliocephalus	Small Cuckoo
21	Puivialis apricaria	Golden Plover (Tithi)
22	Circus aeruginous	Marsh Harrier (Saled Sira)

Table 3 : List of Non-Migratory Bird Species in and around Karwar Lake (Gegusarai), Bihar, India

	Genus Species	
1	Podiceps rufficollis	Little Grebe (Pandubi)
2	Phalacrocorax fuscicollis	Indian Shag
3	Phalacrocorax niger	Little Cormorant (Pankowwa)
4	Phalacrocorax carbo	Large Cormorant
5	Ardea cinerea	Grey Heron (Kubid or Khalra)
6	Arcead purpurea	Purple Heron (Khair)
7	Ardea alba	Large Egret (Bagula)
8	Babulcus ibis	Cattle Egret (Gai Bagula)
9	Egretta garzetta	Little Egret (Bagula)
10	Egretta gularis	Indian Reof Heron
11	Ardea insignis	Great Whitedellied Heron
12	Ardeola grayii	Pond Heron (Andha Bagula)
13	Egretta intermedia	Smaller or Medium Egret (Bagula)
14	Anastomus oscitans	Openbellied Stork (Ghonghail)
15	Threskiarismelanocephala	White ibid (Mandul)
16	Gallicrex cinerea	Water Cock (Kora)
17	Perphyrio porphyrio	Purple Moorhen (Karian)
18	Ceryle rudis	Pied Kingfisher ()Bhobinia)
19	Hirundo smithii	Wiretailed Swallow
20	Hirundo rustica	Kastern Swallow (Ababeel)
21	Hirundo fluvicola	Cliff Swallor
22	Pelecanus phillipensis	Grey Pelican (Bhairwa)
23	Denarocygne fawanica	Lesser Whisling Teel (Silli)
24	Helister indus	Brahminy Kite (Dhobia Cheel)
25	Meiopidius indus	Bronzewinged Jacqna (Karauwa)
26	Postratula bengalensis	Pintail Snipe (Raj Chala)

Table 4 : Conservation and Management Strategies being adopted for Kawar Lake (Begusarai), Bihar, India, for development of the "Bird Sanctuary"

A CONSERVATION

(i) Protection :
Notification of the areas, fancing, zoning of fishing areas

(ii) Maping :
Maping of lake and its catchment areas

(iii) Landscape Planning :
Beautification, land use pattern, afforestation and soil conservation

(iv) Hydrology :
Planning of water inflow & outflow, siltation ratio etc.

(v) Encroachment Removal :
Manmade Barricades removal & encroachment stoppage

(vi) Eutrophication Abatement :
Stopping sewage and other pollutants coming to lake

(vii) Aquatic weed Control :
Auatic weed control — Biological and Mechanical

(viii) Identification :
Govt's identification and notification in their action plans, innumeration of flora and fauna

(ix) Fishery Development :
Fishing in limited sectors with modern technology

(x) Environmental Awareness :
People's environmental awareness education by posters, audio- visuals, seminar etc.

B. MANAGEMENT

(i) Pollution Abatement action plans

(ii) Conservation of Biological resources available in the lake

(iii) Landscape Development

(iv) Afforestation in the periphery of the Lake

(v) Aquaculture Development

(vi) Data collection and survey

(vii) Specific problem for identification

(viii) Organisation and administrative machinery for systematic management

(ix) Necessary legislation by the Government and its implication

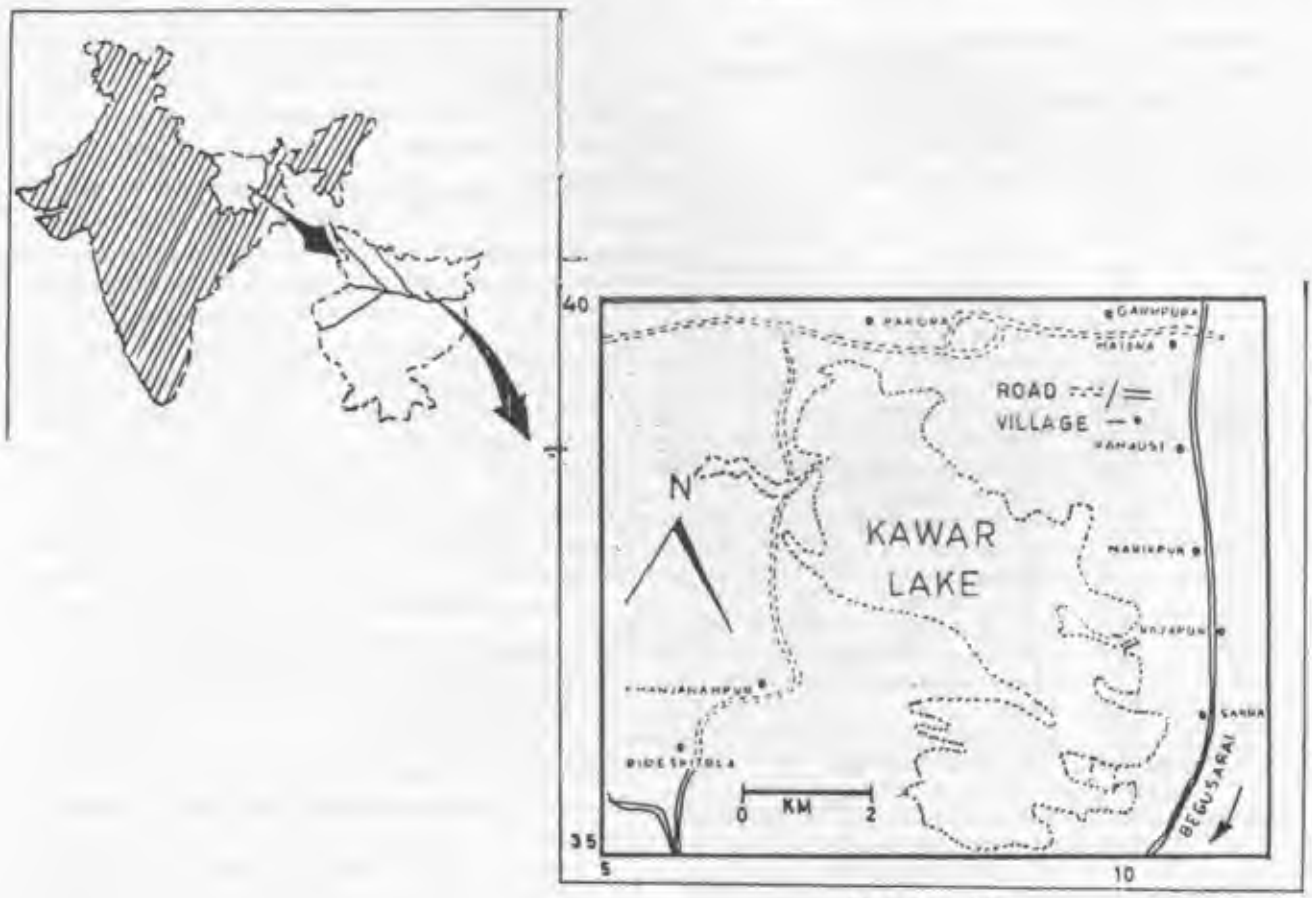

Fig. 1. Kawar Lake

Birds of the Scrub Forest Around Madras City

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The scrub jungles along the Coromandel coast are a highly endangered ecosystem. This is also a favoured habitat for the Great Horned Owl (*Bubo bubo*). We have made observations on the birds of the scrub jungle areas around Madras with special references to this species. The maximum number of birds seen in a suitable area was six and this area is heavily disturbed.

In general, the specialized scrub birds are decreasing in numbers at the places where human incursion is on the increase. In modified habitats, the number of species is usually more but the number of specialized species decrease.

Changing Habitats of Birds in Dakshina Kannada District

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Dakshina Kannada District (D.K.) has a geographic area of 8441 sq km with a straight coast lines of about 141 km. The varied elements of the landscape of the district offer a variety of habitats for both migratory and resident birds. 350 species of birds of which 49 migratory have been identified. Of late, many habitats of birds in the district are severely changed, affecting bird life.

The sandy sea shore with some rocky patches all along offer an ideal habitat for the following important migratory birds: *Larvus brunnicephalus, Sterna caspicum, Sterna hirundo, Pluvialis squatarola, P.dominica, Charadrius mongolus, C.dubius, Arenaria interpres, Tringa hypoleucos, T.orchropus, T.nevularia, T.totanus, T.terek, Calidris alba, Recurvirostra avosetta* and *Haematopus astraleous*. Unfortunately, at many places the sea shore is experiencing an intense erosion and as a measure to prevent this erosion granite boulders are being dumped on the sandy shore. This has altered the basic structure of the shore, adversely affecting the feeding grounds of the shore birds.

The D.K. district produces a third of all the tiles produced in the country. The top soil of agricultural land is being excavated for the purpose, which leaves behind vast stretches of wastelands. The disturbances of agricultural lands have affected the following birds: *Pluvialis dominica, Glareola lactea*, several species of *Tringa, Bubulcus ibis, Galerida malabarica, Dicrurus adsimilis, Merops orientalis, Acridotheres tristis, Vanellus indicus, Egretta intermedia, E.gularis, E.garzetta*.

Extensive deforestation and loss of tall trees have affected forest birds. The birds such as *Haliaectus leucogaster, Sarcogyps calvus, Gyps bengalensis, Anthrococerus coronatus* which nest on tall trees have become very rare and are likely to disappear if proper conservation measures are not carried out.

The D.K. district has a few mangrove complexes and many large mud flats. An attempt to convert these mud flats into mangrove forest is tried. Apart from other effects, this attempt would certainly come in the way of feeding by shore birds particularly *N.arguata, N.phaeopus, T.totanus, T.nebularia, T.glareola, Calardis alba*. Another major habitat disturbance is that of marsh lands. The birds affected by the loss of marsh lands are *Ixobrychus cinnamomeus, I.flavicollis, Butorides striatus, Amaurornis phoenicurus*, and *Prinia socialis*.

High population density (319 per sq km), rapid industrialisation and extensive urbanisation are changing the bird habitats in the district. The local authorities should not encourage these activities.

Ranganathittu Bird Sanctuary

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Introduction

Ranganthittu is small, silent, scenic place, where the famous Kaveri river bifurcates and its one branch flows into a small reservoir formed by a weir constructed across the flowing waters by one of the well-known kings of Mysore known as Kantheerva Wodeyar, nearly 400 years ago (1645-1648). The impounding of the flowing waters encircled higher lands in the wide river-bed forming a number of small islets which got covered by the rivarian vegetation consisting of *Terminalia arjuna* (Arjun), *Syzygium* spp. (Jamun), *Salix* sp. (Indian Willow), *Pongamia pinnala* (Indian Beech tree), *Vitex* spp., *Pandanus* sp. (Screw-pine), *Ficus* spp., *Pithecellobium duke* (Vilayati-imbili), bamboos, reeds and grass caesalpineae, prickly shrubs, etc.

Water birds have been flocking for breeding between June and November. A favorable niche is created for the heronry birds to breed on the insulated islets, surrounded by deep waters that offer natural protection against the land predators like the mangoose, land monitors, jungle cats, civet cats, toddy cats, monkeys, etc. Even man, cattle and his pets are kept away from reaching the islets due to deep waters. In addition, another essential and important requirement of the breeding birds viz. food is made available both in the impounded waters and in the surrounded irrigated paddy fields.

Further the vegetation along the river banks and on the islets provide the nesting materials.

The credit for getting Ranganathittu declared a bird sanctuary in July 1940 should go to our internationally famous ornithologist, the late Dr Salim Ali. During his survey of the birds of the then Mysore State in 1940 as summoned by the Government of Mysore, Dr Salim Ali accidentally came across this heronry and was naturally amazed to see the spectacular congregation of the water and water birds for breeding on the islets in the midst of the swollen Kaveri river. On returning to Mysore the same evening he prevailed upon the Government of Mysore to declare Ranganathittu a bird sanctuary (Ali and Ripley, 1968).

The Heronry Birds

The main breeding season of the heronry birds at Ranganathittu is from June to November. Fourteen species of birds congregate here for breeding as detailed below : (Neginhal, 1983 and 1992).

1. The Large Cormorant (*Phalacrocorax carbo*)
2. The Indian Shag (*P.fuscicallis*)
3. THe Little Cormorant (*P. niger*)
4. The Darter or Snake-bird (*Anhinga rufa*)
5. The Spoonbill (*Platalea leucorodia*)
6. The Large Egret (*Egretta alba*)
7. The Median Egret (*Egretta intermedia*)
8. The Little Egret (*Egretta grazetta*)
9. The Cattle Egret (*Bubulcus ibis*)
10. The paddy bird or Pond Heron (*Ardeola grayii*)
11. The Night Heron (*Nycticorax nycticorax*)
12. The White Ibis (*Threskiornis aethiptea*
13. The Openbilled Stork (*Anastomus oscitans*)
14. The Purple Heron (*Ardea purpurea*)

These birds do not come together to breed. The Darters, the Little Cormorants and the Night Herons come earlier in the season followed by the Openbilled Storks, Egrets, White Ibises and Spoonbills. The Purple Herons come for breeding quite late in the season - infact after the main breeding season of the other heronry birds is over.

When the water and wader birds leave the Sanctuary after breeding, the Sanctuary welcome yet another series of interesting birds to breed but not on a grandose scale as of the earlier birds, as detailed below :

Other Breeding Birds :

Eastern Purple Herons (Ardea purpurea)

There was no record of the breeding of these birds earlier at Ranganathittu till I discovered the breeding in 1977. These birds breed away from the main heronry from January to June.

Great Stone Plovers (Esacus magnirostris) and the Indian River Tern (Sterna aurantia)

These breed on the small exposed rocks when the river recedes after the rains. The eggs are laid in the depressions of the rocks.

Indian Cliff Swallows (Hirundo fluvicola)

These nest on a single vertical stone standing at the upstream of the river. About 150 to 200 birds nest here.

Streaked Weaver Birds (Ploceus manyar)

These birds breed after the rains on the vegetation hanging down on the islets.

Other interesting birds

The Pied Kingfisher (*Ceryle rudis*), The Large Pied Wagtail (*Motacilla maderaspatensis*), Munias (*Lonchura spp*) are the other birds seen after the rains. Recently some Painted Storks (*Mycteria leuicocephala*) were seen nesting here which was not observed earlier. This shows that there is some definite change in the conditions of the

Ranganathittu environs. The Common Peafowl (*Pavo cristatus*) breeds on the main island.

In winter the migratory birds like the Lesser Whistling Teal (*Dendrocygna javanica*), the Osprey (*Pandion haliaetus*) and the Pale Harrier (*Circus macrourus*) visit the Sanctuary. The locally migratory birds viz. the Whitenecked Storks (*Ciconia episcopus*) and the Spotbill Duck(*Anas poecilorhyncha*) visit the sanctuary in summer.

Prey Birds

The Shikra (*Accipiter badius*), the Crested Serpent Eagle (*Spilornis cheela*) and the Brahminy Kite (*Haliastur indus*) are the prey birds observed in the Sanctuary.

Predation

Crows (both *Corvus macrorhynchos* and *C. splendens*) cause heavy damage to the eggs and the nestlings of the breeding birds. The Brahminy Kite (*Haliastur indus*) is also sometimes observed snatching the nestlings. The Bonnet macaques (*Macaca radiata*) used to swim in the river and reach the breeding colonies to pillage the eggs. The wildlife wing of the Forest Department did an excellent job in trapping these and releasing them in far-off forests. So now this damage is not observed.

Other Depredations

Annually the water from the KRS dam is released on a very large scale which washes off the nests, eggs and the nestlings that are found on the lower portions of the vegetation. In 1991 the floods washed off even some of the islets and rivarian vegetation on which the heronry birds used to breed. Nearly two lakhs tourists visit this sanctuary every year. The birds are disturbed when the tourists go very near the breeding birds, inviting crows to come to pillage the eggs. Infact crows follow the boats!

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Habitat Preference of Birds of Neria

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Introduction

Studies on habitat preference of birds are valuable for developing appropriate conservation strategies. In the present survey a preliminary attempt was made to analyse the nature of habitats preferred by certain birds of the Neria Forest.

Material and Methods

The field study was undertaken for one month (i.e. from 30th Jan to 25th Feb, 1993). The Neria Forest selected for the survey is located at the foot of the Western Ghats in Belthangady Thaluk of Dakshina Kannada District and covers about 4,000 hectares. The vegetation consists of evergreen tropical forest and plantation of rubber, areca, coconut, etc. The annual rainfall is 190 inches and the temperature ranges from 18°C to 32°C.

A transect of 1 km length was laid in the low elevation (100-150 m) strata of the study area covering most of the habitat types. The study area could be broadly divided into the following three types :

Type I (Open): Habitat is degraded with scanty vegetation, mostly grass. Here the human activity is the greatest.

Type II (Bush): This is partially degraded habitat; with Bamboo, Ixora and a few herbs. Human activity is moderate.

Type III (Forest): This consists of secondary and regenerated forest with trees not more than 15 years old. The human activity here is negligible.

Nearly 30% of the area covered in the study constituted type-I habitat. The type-II had about 20%. About 50% was occupied by Type-III habitat. Ten points were marked along the transect with a distance of 100 m between two points.

The field for sighting the birds extended to about 50 m on either side of the transect. The birds were sighted by tracking both during morning and evening hours (8 a.m. to 10 a.m. and 4 p.m. to 6 p.m.). At each point sighting was made for about 12 min. All the birds sighted during this period were identified and recorded in the field notebook. The observation was continued for about 2 hours to cover the 10 points.

Results and Discussion

Sixty one species of birds were found to occur here. Of these, 19 were found to have a definite habitat preference (Table- 1) and hence were consistently occupying either of the three habitats. Further 7 species viz., *Dicrurus adsmillis* (Black Drongo), *Loriculus vernalis* (Indian Lorikeet), *Dicrurus paradiseus* (Racket-tailed Drongo), *Corvus macrohynchos* (Jungle Crow), *Pycnonotus cafer* (Redvented Bulbul), *Pericrocotus flammeus* (Scarlet Minivet), and *Arachnothera longirostris* (Small Spiderhunter), were found to prefer the open habitat (Type 1). *Nectarinia zeylonica* (Purplerumped Sunbird), *Galloperdix spadices* (Red Spurfowl) and *Pycnonotus melanicterus* (Blackheaded Rubythroated Yellow Bulbul), *Aegithina tiphia* (Common Iora) (five species) were seen in bushy habitat (Type II).

Of the remaining birds, two species, *Rhopocichla atriceps* (Blackheaded Babbler) and *Dicaeum erythrorhynchos* (Tickell's Flowerpecker) were occupying both bush and forest type of habitats. Similarly another four species like *Oriolus oriolus*, *Treron phoenicoptera* (Common Great Pigeon), *Pynconotus jocosus* (Redwhiskered Bulbul), *Pycononotus priocephalus* (Greyheaded Bulbul) were occupying both open and bush type of habitats. Interestingly, *Hypsipetes indicus* (Yellow browed Bulbul) was found to prefer equally the open, bush as well as the forest type of habitats.

The study showed greater richness in the bush type rather than the other two types. An example of the feeding habits of the birds in the three habitats does not suggest any definite relationship. The tentative conclusion therefore, is that habitat preference of a group of species is by no means an indication of their feeding habits.

Acknowledgements

We wish to record our gratitudes to Prof. S.N. Hegde, Head of the Applied Zoology, Zoology Division, Mangalore University, Mangalagangothri.

Table 1 : Habitat-wise distribution of birds in a study area, i.e. The Neria Forest

S.No.	Name of the Bird	Point Numbers										Total	Habitat preferences
		1	2	3	4	5	6	7	8	9	10		
1	Black Drongo	2	3	3	1	2	0	0	0	2	0	13	1
2	Blackheaded Babbler	0	0	0	0	0	4	0	0	9	0	13	2+3
3	Rubythroated Yellow Bulbul	4	0	4	20	13	10	4	6	3	8	72	2
4	Common Iora	0	1	2	2	1	5	1	0	0	0	12	2
5	Fairy Blue Bird	0	2	1	11	5	0	3	0	0	1	23	2
6	Golden Oriole	3	12	5	7	6	1	0	0	0	0	34	1+2
7	Green Pigeon	0	2	3	6	0	0	0	0	0	0	11	1+2
8	Indian Lorikeet	13	10	9	1	2	2	2	2	0	3	0	42 1
9	Purplerumped Sunbird	1	2	5	7	11	12	16	5	1	4	64	2
10	Racket-tailed Drongo	2	5	3	0	1	0	0	0	0	2	13	1
11	Red Spurfowl	0	0	1	3	2	0	3	2	0	0	11	2
12	Redvented Bulbul	7	1	2	2	0	0	0	0	0	0	12	1
13	Redwhiskered Bulbul	6	5	4	13	3	0	0	0	0	0	31	1+2
14	Jungle Crow	7	4	0	1	0	0	0	0	2	0	14	1
15	Scarlet Minivet	5	4	6	0	3	0	0	2	0	2	22	1
16	Small Spiderhunter	1	6	2	1	3	2	0	0	2	2	19	1
17	Tickell's Flowerpecker	2	3	7	5	16	13	10	4	12	10	82	2+3
18	Yellowbrowed Bulbul	4	0	5	8	7	5	6	6	2	3	46	1+2+3
19	Greyheaded Bulbul	10	11	6	9	8	8	9	7	2	6	76	1+2

Habitat 1 = Open Type;
Habitat 2 = Bush type;
Habitat 3 = Forest type

Avifauna of Udhampur (Jammu & Kashmir) District

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Introduction

Udhampur is a hilly town of Jammu & Kashmir with the Tawi river flowing across. Udhampur has four seasons: Winter (December to March), Spring (April to June), Monsoon (July to September) and Autumn (October to November). It snows in the winter in the surrounding areas, except Udhampur. Perphaps this is the prime reason for the concentration of so many species of birds ranging from the Tits, Chats, Thrushes, to the Longbilled Vultures and Himalayan Griffons in this pocket.

The altitude of Udhampur is 630 m, situated in the 32°54é north and 75°09é east. The temperature varies between 41.5°C (June), and -01.6°C (January). The rainfall as recorded between this survey period was found to be of a maximum of 521 mm/month, (recorded in July '93) and a minimum of 0.7 mm/monthly (recorded in November '91).

The Survey Period was from October 1st 1991 to July 31st of 1993. A checklist of the birds sighted during this period is enclosed herewith.

Udhampur district, falls in the Lower Himalayan Range. Lying between the Pirpanjal and Siwalik ranges the district of Udhampur is an unique spot experiencing two specific zones - the snowfall area, and the non snowfall area. To the north of the Udhampur district flows the Chenab river, and the Tawi river directly crosses the survey area. The vegetation is sub-tropical Pine forest with moist temperate forest at higher altitudes immediately above this region.

Material And Methods

The survey of the avifauna of this area was undertaken for a period of 22 months. The birds were observed from very close quarters and almost all species have been photographed. Deserted bird-nests, egg shells, and feathers have been collected. A list of 136 species of birds belonging to 42 families along with their status and occurence is presented in the checklist. The birds were identified by the books referred below.

Results and Discussion

Some interesting findings

January - February when Udhampur normally finds cold winter climate, abruptly on January 27th, a warm wind began to blow as if signalling the arrival of Spring. Two days after, on the 29th, Spring arrived much too early. Consequently the Semul (Red Silk Cotton) trees bloomed profusely and Blossomheaded Parakeets, and Indian-Hawk Cuckoos filled the air with joyful shrills. February 17th - Udhampur witnessed a severe hailstorm with speedy wind. Winter returned again, as Spring vanished, bringing life back to a state of cold and chill.

Change in food items

Trouts, tadpoles, frogs, tree frogs, and toads – are the food of Kingfishers and Pond Herons. During scarcity of the above, insects supplement the diet.

July 12th '93 - A fledgling of the Indian Cuckoo (*Cuculus micropterus*) was being regularly fed by a Drongo (*Dicrurus adsimilis*) foster mother. The chick remained on a branch and declared its presence with a sharp shrill, shaking its wings and voraciously swallowing all that the Drongo mother brought.

A Common Babbler (*Turdoides caudatus*) was found feeding the chick of a Pied Crested Cuckoo (*Clamator jacobinus*). The Cuckoo was observed sitting in association with 4-5 Babbler chicks. Both the feeder and the fed responded to each other very normally. This was noted on the 22nd of July 1992.

June 11th '92 - A Grey Tit's (*Parus major*) nest was discovered in an electric switch box. When I found the chicks they were 15 to 20 days old and numbered 4 or 5. As I brought out a chick for a close look, it flew away from my hand. The Tit's nest was destroyed the day after. A close examination of the nest revealed its compositions: mongoose hair, soft grass and vegetable matter, with dry twine. The nest was soft and much like a sparrow's nest. The chicks survived, and was found to be flying with the mother bird.

Large concentrations of Cattle Egrets (*Bubulcus ibis*) have been noted arriving at Udhampur from the early weeks of March. The birds arrived in large numbers, ranging from 300 to 500. Sometimes small numbers of Little Egrets (*Egretta garzetta*) also arrived. The Cattle Egrets would remain till end of March or early April and maintained a regular routine of arriving at their roost soon after sunset, and left every dawn to nearby fields and marshes, where they spent the day.

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Appendix

Avifauna of Udhampur (Jammu & Kashmir) List of Birds Recorded During the Period : 1st October 1991 to 31st July 1993

Sl. No.	Scientific Name	English Name	Status	Occurance
Family : Accipitridae				
1.	Milvus migrans	Pariah Kite	R	F
2.	Elanus caeruleus	Blackwinged Kite	LM	S
3.	Accipiter badius	Shikra	LM	S
4.	Gyps bengalensis	Whitebacked Vulture	R	F
5.	Neophron percnopterus	Scavenger Vulture	LM	S
6.	Gyps himalayensis	Himalayan Griffon Vulture	LM	S
7.	Gyps indicus	Longbilled Vulture	R	F
8.	Aquila nipalensis	Tawny Eagle (Immature plumage)	M	O
Family : Falconidae				
9.	Falco tinnunculus	Kestrel	LM	S
Family : Phasianidae				
10.	Francolinus francolinus	Black Partridge	R	S
11.	Coturnis coturnix	Grey Quail	R	O
Family : Rallidae				
12.	Amaurornis phoenicurus	Whitebreasted Waterhen	R	S,B
Family : Charadriidae (Charadriinae)				
13.	Vanellus indicus	Red Wattled Lapwing	R	F
Family : Columbidae				
14.	Ciolumba livia	Blue Rock Pigeon	R	C
15.	Streptopelia chinensis	Spotted Dove	R	C, B
16.	Streptopelia decaocto	Collared Dove	M	F, B
17.	Streptopelia tranquebarica	Red Turtle Dove	LM	B
18.	Streptopelia senegalensis	Little Brown Dove	M	S, B
Family : Psittacidae				
19.	Psittacula krameri	Roseringed Parakeet	R	F
20.	Psittacula eupatria	Alexandrine Parakeet	R	F
21.	Psittacula cyanocephala	Blossomheaded Parakeet	M	F, B
22.	Psittacula himalayana	Slatyheaded Parakeet	M	B
Family : Cuculidae				
23.	Eudynamys scolopacea	Koel	M	F, B
24.	Centropus sinensis	Coucal		(extremely rare)
25.	Cuculus varius	Common Hawk-Cuckoo	M	B
26.	Clamator jacobinus	Piedcrested Cuckoo	M	B
27.	Cuculus micropterus	Indian Cuckoo	M	B
28.	Taccocua leschenaultii	Sirkeer Cuckoo	M	O
Family : Strigidae (Striginae)				
29.	Glaucidium cuculoides	West Himalayan Barred Owlet	R	F
Family : Caprimulgidae				
30.	Caprimulgus asiaticus	Indian Nightjar	M	O (presently not found)
Family : Apodidae (APodinae)				
31.	Apus affinis	House Swift	R	C

Sl. No.	Scientific Name	English Name	Status	Occurance
Family : Alcedinidae				
32.	Halcyon smyrnensis	Whitebreasted Kingfisher	LM	F, B
33	Ceryle rudis	Pied Kingfisher	M	O
Family : Meropidae				
34.	Merops orientalis	Little Green Bee-eater	M	B
35.	Merops philippinus	Bluetailed Bee-eater	M	B
Family : Upupidae				
36.	Upupa epops	Hoopoe		R F, B
Family : Bucerotidae				
37.	Tockus birostris	Grey Hornbill	M	O
Family : Capitonidae				
38.	Megalaima zeylanica	Green Barbet	M	B
39	Megalaima asiatica	Bluethroated Barbet	M	F, B
40.	Megalaima haemacephala	Crimsonbreasted Barbet	M	O
Family : Picidae				
41.	Picoides auriceps	West Himalayan Brownfronted Pied Woodpecker	M	O
42.	Dinopium benghalense	Goldenbacked Woodpecker	M	O
Family : Hirundinidae				
43.	Hirundo rustica	Common Swallow	R	F
44.	Hirundo smithii	Indian Wiretailed Swallow	M	O
Family : Laniidae				
45	Lanius schach	Rufousbacked Shrike	R	C
46.	Lanius excubitor	Indian Grey Shrike	extremely rare	
Family : Oriolidae				
47.	Oriolus oriolus	Golden Oriole	M	B
Family : Dicruridae				
48	Dicrurus adsimilis	North Indian Black Drongo	M	B
Family : Sturnidae				
49	Sturnus pagodarum	Brahminy Myna	M	B
50.	Acridotheres tritis	Common Myna	R	C
51	Acridotheres fuscus	Jungle Myna	M	C,B
52.	Acridotheres ginginianus	Bank Myna	extremely rare	
53.	Sturnus vulgaris	Kashmir Starling	M	O
Family : Corvidae				
54	Corvus splendens	Sind House Crow	R	S
55.	Corvus macrorhynchos	Himalayan Jungle Crow	R	C
56.	Dendrocitta vagabunda	Tree Pie	R	C
Family : Campephagidae				
57.	Tephrodornis pondicerianus	Sind Wood Shrike	M	S
58.	Coracina novaehollandiae	Cuckoo Shrike	extremely rare	
59	Pericrocotus cinnamomeus	Small Minivet	M	S
60	Pericrocotus flammeus	Scarlet Minivet	M	S
Family : Pycnonotidae				
61.	Pycnotus cafer	Redvented Bulbul	R	C,B

Sl. No.	Scientific Name	English Name	Status	Occurance
62.	Pycnonotus leucogenys	Whitecheeked Bulbul	LM	F, B
63.	Hypsipetes madagascariensis	Black Bulbul	M	O
Family : Muscicapidae (Timaliinae)				
64	Turdoides striatus	Jungle Babbler	R	C
65	Turdoides caudatus	Common Babbler	LM	S
66	Pellorneum ruficeps	Spotted Babbler	LM	O
67	Chrysomma sinense	Yelloweyed Babbler	LM	S, B
Family : Muscicapidae (Muscicapinae)				
68.	Terpsiphone paradisi	Paradise Flycatcher	M	B
69	Rhipidura albicollis	Whitespotted Fantail Flycatcher	M	O
70	Muscicapa leucomalanura	Western Slaty Blue Flycatcher	M	F
Family : Muscicapidae (Sylviinae)				
71	Phylloscopus occipitalis	Large crowned Leaf Warbler	M	F
72	Seicercus xanthoschistos	Greyheaded Flycatcher Warbler	M	S
Family Muscicapidae (Turdinae)				
73.	Turdus merula	Black Bird	extremely rare	
74	Copsychus saularis	Magpie Robin R C		
75	Saxicola caprata	Pied Bush Chat	M	F
76.	Saxicola torquata	Indian Collared Bush Chat	M	F
77	Saxicola ferrea	Dark Grey Bush Chat	M	F
78	Cercorneia fusca	Brown Rock Chat	M	O
79.	Chaimarrornis leococephalus	Whitecapped Redstart	M	O
80.	Rhyacornis fuliginosus	Plumbeous Redstart	M	O
81.	Saxicoloides fulicata	Indian Robin	LM	B
82.	Myiophoneus caeruleus	Himalayan Whistling Thrush	M	C
83.	Turdus feai	Fea's Thrush	M	O
84	Monticola solitarius	Blue Rock Thrush	M	O
85.	Turdus boul	Greywinged Black Bird	extremely rare	
86.	Turdus,viscivorus	Missel Thrush	M	O
Family : Podichipedidae				
87.	Podiceps ruficollis	Little Grebe	R	C, O
Family : Phalacrocoracidae				
88.	Phalacrocorax carbo	Large Cormorant	extremely rare	
Family : Ardidae				
89	Ardeola grayii	Pond Heron	R	F
90.	Bubulcus ibis	Cattle Egret	LM	F
91	Egretta garzetta	Little Egret	M	S
92.	Egretta alba	Large Egret	M	O
Family : Phasianidae				
93.	Francolinus pondicerianus	Grey Partridge	R	O
94.	Bambisicola fytchii	Bamboo Partridge	R	O
95	Galloperdix spacicea	Redspur Fowl	R	O

Sl. No.	Scientific Name	English Name	Status	Occurance
Family : Cuculidae				
96	Cuculus canorus	Cuckoo	M	F
97.	Surniculus lugubris	Indian Drongo Cuckoo	M	O
Family Picidae				
98.	Jynx torquilla	Kashmir Wryneck	extremely rare	
Family : Muscicapidae (Muscicapinae)				
99	Muscicapa lencomelanura	Western Slaty Blue Flycatcher	M	S
100.	Muscicapa sundara	Western Rufousbellied Niltava	M	O
101	Culicicapa ceylonensis	Greyheaded Flycatcher	M	O
102.	Rhipidura hypoxantha	Yellowbellied Fantail Flycatcher	M	O
103.	Alsenax ruficaudus	Rufoustailed Flycatcher	M	S
Family : Muscicapidae (Sylviinae)				
104.	Bedypterus luteroventris	Brown Bush-Warbler	LM	S
105.	Pirnia socialis	Northern Ashy Wren-Warbler	M	O
106.	Prinia buchanani	Rufousfronted Wren-Warbler	M	F, B
107.	Prinia subflava	Indian Wren-Warbler	M	S
108.	Prinia criniger	Himalayan Brown Hill Warbler	M	S
109.	Phylloscopus inornatus	Yellowbrowed Leaf Warbler	M	S
110	Phylloscopus collybita	Brown Chiff Chaff	M	S
111	Orthotomus sutorius	Tailor Bird	R	F, B
Family : Muscicapidae (Turdinae)				
112.	Zoothera dauma	Smallbilled Golden Mountain Thrush	M	O
113.	Monticolla rufiventris	Chestnutbellied Blue Rock Thrush	M	O
Family : Paridae (Parinae)				
114.	Parus major	Kashmir Grey Tit	R, LM	F
Family : Certhidae				
115.	Certhia familiaris	Kashmir Tree Creeper	M	S
Family : Motacillidae				
116	Anthus novaescelandiae	North-Western Paddy Field Pipit	LM	S
Family : Motacillidae				
117.	Motacilla citreola	Blackbacked Yellowheaded Wagtail	M	O
118.	Motacilla madraspatensis	Large Pied Wagtail	M	S
119.	Motacilla flava	Blueheaded Yellow Wagtail	M	S
120.	Motacilla alba	White Wagtail	M	S
Family : Dicaeidae				
121.	Dicaeum ignipectus	Firebreasted Flowerpecker	extremely rare	
Family : Nectarinidae				
122.	Nectarinia asiatica	Sind Purple Sunbird	M	F, B
123.	Aethopyga siparaja	Yellowbacked Sunbird	M	O
Family : Zosteropidae				
124.	Zosterops palpebrosa	Indian White-eye	LM	F, B
Family : Ploseidae (Passerinae)				
125.	Passer montanus	Tree Sparrow	M	O
126.	Passer domesticus	Kashmir House Sparrow	R	C

Sl. No.	Scientific Name	English Name	Status	Occurance
Family : Ploceidae (Ploceinae)				
127.	Ploceus manyar	Indian Streaked Weaver Bird	M	B
Family : Ploceidae (Estrildinae)				
128.	Lonchura malabarica	Whitethroated Munia	M	O
129.	Lonchura punctulata	Spotted Munia	M	S,B
Family : **Fringillidae (Fringillinae)**				
130.	Carduelis spinoides	Himalayan Green Finch	M	O
131.	Carpodacus erythrinus	Common Rosefinch	M	F
Family : **Emberizidae**				
132.	Emberiza cias	Himalayan Rock Bunting	M	O
133.	Melophus lathami	Crested Bunting	M	O
			New Inclusions	
Family : Muscicapidae (Turdinae)				
134.	Turdus unicolor	Tickell's Thrush	M	O
Family : Muscicapidae (Sylviinae)				
135.	Seicercus burkii	Western Blackbrowed Flycatcher Warbler	M	O
136.	Phylloscopus affinis	Tickell's Leaf Warbler	M	S

Wetlands of Shimoga City

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Shimoga city, situated amidst the once dense forests of Malnad area was known as "Queen of Malnad". Now the forest tracts have been reduced to a few reserve forest zones such as Shetyhalli, Bhadra, Sharavathi, Mandagadde and Gudavi.

Shimoga has about 15 wetlands, two of which are described below:

1. Navale Tank

It is situated 3 km from Shimoga towards North, encompassing about 5 acres of area. Currently about 40% of the area is filled up by water hyacinth and *Besharam* plants, and remaining is clear water for water fowls. This is an unprotected tank.

I observed around 39 waterfowl species and 60 species of terrestrial birds during November and December in 1991 and 1992. Of the birds observed, Sanderling was spotted only once and Baillon's Crake twice, at this tank.

2. CHatnalli Tanks

This is a group of small and medium tanks, situated about 5 kms from Shimoga, towards south-east. The total area is about 4.5 acres. The main wetlands of this tank are as follows.

(a) Tyaware Chatnalli Tank

It has an area of 2.5 acres. Dried parts of about 20% has been used for cultivation. Though this is unaffected by external pollution, poachers kill Lesser Whistling Teals, Coots and Purple Moorhens. This tank is also an unprotected one. 70% of the tank is filled with Water hyacinth and Congress grass. In this tank, I have observed 10-15 species of waterfowl. Besides, Indian Courser and Openbilled Storks were observed once.

(b) Ghondhi Chatnalli

It has an area of 2.5-3 acres. This tank is away from the main road and is surrounded by a village. Just 10% of the tank has clear water and other parts are full of grasses and Water hyacinths. Poaching is common. Many waterfowls are found here.

For the conservation of these wetland ecosystems the following measures are suggested

Fence the tank to protect from encroachment and poaching. Erect name boards for all the major tanks, depicting brief description of avifauna.

Create a general awareness among the people, about this ecosystem.

Acknowledgements

I am grateful to the members of Shimoga Birdwatchers Club and to my brother K.V. Chandrakantha for their cooperation and assistance rendered in the field.

Ecological Study of Nal Sarovar Bird Sanctuary Using Remote Sensing Technology

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Introduction

The Nal Sarovar Wetland is a large natural lake of irregular shape. It is situated at a distance of about 64 km from Ahmedabad. It falls in the administrative boundaries of Ahmedabad and Surendranagar districts. The nearest town is Vekaria, where the inspection bunglow of Forest Department is located.

The Nal Sarovar is often a seasonal lake. As it is a natural depression, lake receives rain water from all the surrounding areas by small nalas, branch of river Bhogavo and Bamni river. The water table of the lake varies from year to year and season to season. It mainly depends on the rainfall in the catchment area of the lake. The maximum water depth is 2 m.

This large wetland is ecologically very unique. After monsoon, it is full of aquatic vegetation, invertebrates and fishes. These make the Nal Sarovar an ideal wintering habitat for large number of birds of various species.

The waterfowl census figures of January – 1992 are given in Table 1.

The wetland ecosystem of Nal Sarovar is recognised as internationally important wetland under the guidelines of the Ramsar Convention by the Government of India. The Government of Gujarat, declared 115.00 sq km of the lake area as Nal Sarovar Bird Sanctuary in the year 1969 vide notification No. GH/KH/381/WLP/1068/74322-P, dated 08.04.1969, and another 5.82 sq km of area was added by notification No. AKH/238/82/1082/26121-V2, dated 27.12.1982, comprising the total area of 120.82 sq km.

For better management of the sanctuary and improving the habitat of migratory waterfowls, ecological study is very essential. It is essential to know the area of lake under water, area occupied by aquatic vegetation, depth of the water at various places and other ecological parameters affecting the ecology of the wetland. This is not possible by any direct method as the area is very large and easy movement is not possible. Therefore, use of remote sensing technique has been made to study some of the ecological parameters of Nal Sarovar bird sanctuary.

Objectives

(a) To attempt the assessment of water spread in the Nal Sarovar bird sanctuary

(b) To attempt the assessment of area occupied by aquatic vegetation

(c) To study other ecological parameters

(d) To give necessary suggestions for the better habitat management of the sanctuary through remote sensing techniques.

Material and Methods

Primarily this study was limited to the Nal Sarovar bird sanctuary area, which falls in the premises of Ahmedabad and Surendranagar districts. After extensive field visits it was also decided to study the surrounding area of the sanctuary, as these areas are also important for the waterfowls. Some of these areas are roosting, nesting and feeding grounds of the waterfowls and wetland associated birds. Management practices in the surrounding area is also likely to effect the ecosystem of the sanctuary.

Data Used

Satellite data

For this study LISS – II data of the Indian Remote Sensing Satellite (IRS) — IA used.

The management map of sanctuary showing latitude, longitude, roads, villages and sanctuary boundary is used for preparing base maps.

Equipment Used

PROCOM-2

In this study PROCOM-2 is used for enlarging satellite data to the mapping scale of 1:50,000. This instrument is composed of a projector, data carrier, zoom lens, beam deflector, control box, working surface and supporting frame. This sturdy desk-top instrument enables the user to enlarge and scan transparencies of satellite data.

This projector illuminates the transparency placed in the data carrier. The data carrier can be moved in the orthogonal directions, thus permitting the operator to roam visually across the scene. The zoom enlarges the projected image to the desired scale and the front surface mirror of the beam deflector direct the light beam on the working surface (Table 3).

Air conditioner

An air conditioner is used to maintain the optimum room temperature, while working on PROCOM–2 to avoid any damage to satellite imagery from heat.

Light table

For viewing the transparencies and other cartographic work a light table is used.

Drafting machine

The universal drafting machine of KILBURN is used for the preparation of final maps.

Cartographic materials

Cartographic materials like rotring pens, tracing films, clutch pencils, measuring scales etc., are used to prepare the final maps.

The various aspects covered here in the chapter of methodology includes procedure of selection of remote sensing data, mapping scale, ground truth collection, classification adopted, final mapping, area calculation, area computation and accuracy estimation etc. The details of each step of methodology is given as under :

Selection of remote sensing data

The primary objective of IRS is to provide the systematic repetitive acquisition of high revolution multispectral data of the earth's surface under constant illumination conditions. IRS is operating in circular sun-synchronous near polar orbit at an inclination of 99.02 degrees at an altitude of approximately 904 km., descending node. The satellite circles the earth every 103.2 minutes completing 14 orbits per day. Entire earth is covered by 307 orbits during 22 days cycle.

The IRS launch time was so chosen that the descending nodal time, i.e. local time, is realised, around 10:25 a.m. The IRS payload consists of two Linear Imaging Self Scanning Sensors (LISS).

LISS –2 I : Consist of a camera operating in four bands in the 0.45 — 0.86 micron spectral region, with geometric resolution of 72.5 cm and a swath of 148.48 km.

LISS – II : Consist of two cameras operating in the four bands in the 0.45 — 0.86 micron spectral region with a geometric resolution of 36.35 m each with a swath of 74.24 km. The combined swath of the two cameras, allowing a 1.5 km. overlap between them, is about 146.90 km. The cameras of IRS operate in pushbroom scanning mode using CCD linear arrays of 2048 elements. Remote sensing technique has given the synoptic view of the entire Nal Sarovar area and its landuse pattern, drainage pattern and habitat distribution (see Table 2).

Results And Discussion

Study showed that much of the potential wetland habitat remains outside the legal sanctuary boundary. It was also observed that most of the islands do not show any vegetation cover. The only island having thick vegetation cover was Dhrabla. There are very few pockets of vegetation in and around the sanctuary and the dominant tree species was *Prosopis juliflora*.

The surrounding area of the existing sanctuary boundary, which remains submerged during the monsoon months is also very important area for the waterfowl management. This area shows good growth of aquatic vegetation. It provides tubers, grasses, seeds and benthic fauna particularly from the muddy area, which is being used as food by many bird species. Moreover, this area is roosting and nesting grounds of many migratory and resident birds. Therefore, it requires legal protection, and it is suggested that this area should also be included in the sanctuary. So, keeping in mind the construction of two check dams at proposed site, proposed sanctuary boundary is shown in Fig. 1. Thus the total area of proposed sanctuary comes to 335.31 sq.kms.

Repeated monitoring of these classes through remote sensing in every season and correlating this with waterfowl census will be helpful in designing appropriate habitat improvement plans.

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Table 1 : Water Fowl Census Figures January 1991

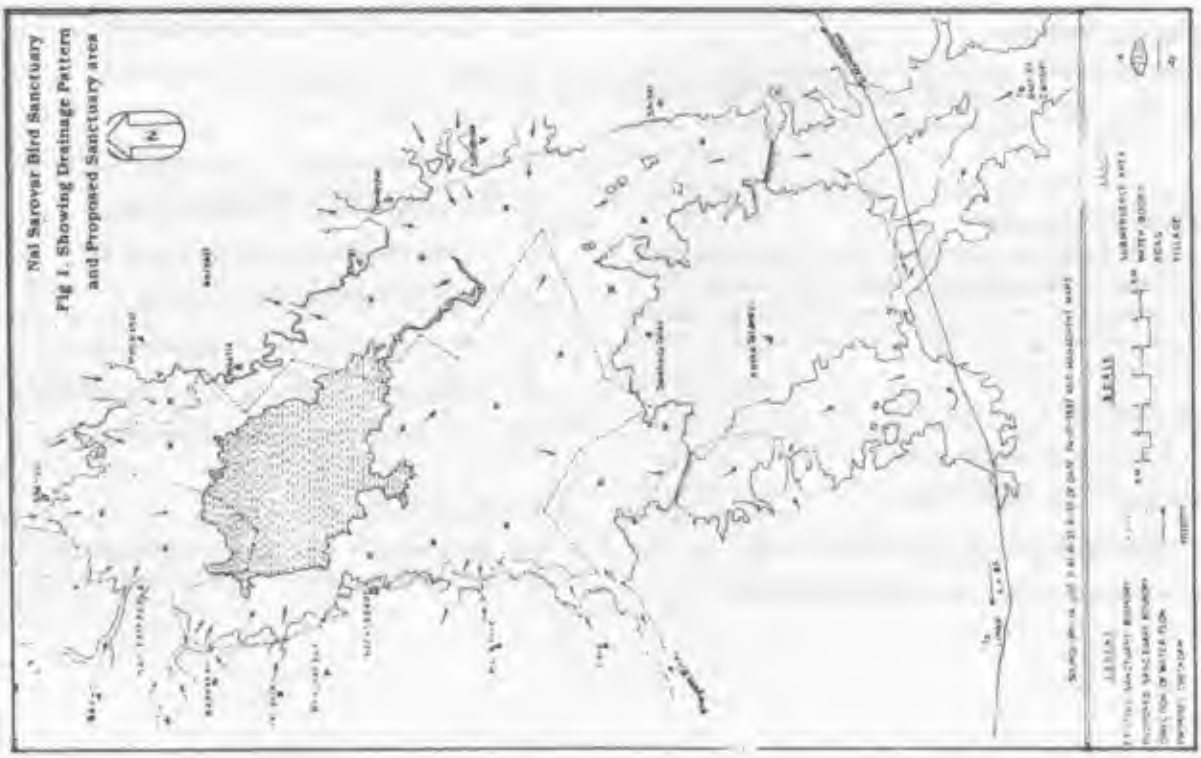
Sr. No.	Group	No. of Species	Estimated No. of Birds
1	Grebes	01	738
2	Pelicans	03	42877
3	Ducks & Geese	20	25074
4	Rails, Coots & Crakes	05	19292
5	Jacanas	01	144
6	Cormorants & Darters	03	785
7	Herons, Egrets & Bitterns	10	8010
8	Storks	05	590
9	Ibises & Spoonbills	04	12062
10	Flamingos	02	10413
11	Cranes	03	32548
12	Waders-Shore Birds	35	63836
13	Gulls	05	2576
14	Terns & Skimmers	07	1983
15	Kingfishers	02	65
16	Other Species	12	3252
	Total	118	224245

Table 2 : Details of Remote Sensing Data Used

#	Satellite	: IRA – IA
#	Sensor	: Linear Imaging Self Scanning (LISS)-II
#	Path	: 32
#	Row	: 52
#	Sub Scene	: B1
#	Data Product	: False colour composite (FCC)
#	Bands	: 2,3,4
#	Date of pass	: 04–01–1992

Table 3 : Main Specification of PROCOM-2

# Power	: 110 – 240 Watts
# Size	: Height 138 cms Width 81 Cms Length 157 cms
# Weight	: 84 kgs
# Viewing mode	: Reflected front projection
# Beam deflector	: Aluminized front surface plane mirror of 40 × 40 cms
# Lenses standard	: 60–300 mm telemacro zoom with 2 × teleconverter 28–80 mm, 200 mm
# Projector	: Modified scientific model with 24 V – 250 V halogen lamp and heat filter
# Cooling	: 2 path, adjustable in projector auxiliary blower for data carrier
# Projection distance	: 2.1 m, folded for convenient operation
# Working area	: 81 × 100 cms
# Magnification	: 6 × – 28 × using 60 — 300 mm lens 3 × – 14 × using 2 × tele-converter 29 × – 72 × using 28 – 80 mm lens upto 100 × using optimal lenses



Birds Recorded During a Visit to the Desert National Park, Rajasthan

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Introduction

The Desert National Park, Jaisalmer, Rajasthan with an area of 3162 sq km in the Thar Desert was formed in 1981 for the protection of the unique flora and fauna of the Thar Desert. In the strict sense it is not a national park as there are villages inside the DNP. But there are core areas of 500–1000 hectares where human interference and stock grazing is banned. The topography of the DNP is varied — fixed and shifting sand dunes, interdunal valleys and vast flat gravel areas. Most of the desert is covered with *Lasiurus, sindicus* grassland and *Acacia* and *Euphorbia* scrubland. Ak (*Calotropis procera*), Kair (*Capparis decidua*) and Phog (*Calligonum polligonoides*) are the common shrubs. At some places the landscape is dotted with Khejri (*Prosopis cineraria*) and Jal (*Salvadora persica*) trees.

The climate is harsh with rainfall between 100–115 mm and droughts are frequent. June is the hottest month and temperature is as high as 50° celsius. Hot winds and dust storms are common in summer. January is the coldest month and temperature may fall down to 2° celsius.

Material and Methods

Observations were made from a four-wheel drive mostly in and around core areas of Sam, Sudasri, Khuri and Miajalar. The DNP was traversed for four days in June, 1993.

Results and Discussion

A total of 29 specie were observed. All the birds were resident except Bluecheeked Bee-eater. Which is a summer visitor and breeds in the desert. This report details the species observed and their relative abundance at the hottest period of the year.

Systematic List

1. Tawny Eagle, *Aquila rapax.*
2. King Vulture, *Torgus calvus.*
3. Whitebacked Vulture, *Gyps bengalensis.*
4. Scavenger Vulture, *Neophron percnopterus.*
5. Short-toed Eagle, *Circaetus gallicus.*
6. Laggar Falcon, *Falco jugger.*
7. Grey Partridge, *Francolinus pondicerianus.*
8. Grey Quail, *Coturnix coturnix.*
9. Great Indian Bustard, *Choriotis nigriceps.*
10. Chestnutbellied Sandgrouse, *Pterocles exustus.*
11. Blue Rock Pigeon, *Columba livia.*
12. Collared Dove, *Streptopelia decaocta.*
13. Spotted Owlet, *Athene brama* (Only heard).
14. Bluecheeked Bee-eater, *Merops superciliosus.*
15. Small Green Bee-eater, *Merops orientalis.*
16. Mahratta Woodpecker, *Picoides maharattensis.*
17. Blackcrowned Finchlark, *Eremopterix nigriceps.*
18. Desert Finchlark, *Ammomanes deserti.*
19. Indian Grey Shrike, *Lanius excubitor.*
20. Indian House Crow, *Corvus splendens.*
21. Raven, *Corvus corax.*
22. Whitecheeked Bulbul, *Pycnonotus leucogenys.*
23. Redvented Bulbul, *Pycnonotus cafer.*
24. Common Babbler, *Turdoides caudatus.*
25. Purple Sunbird, *Nectarinia asiatica.*
26. Indian House Sparrow, *Passer domesticus.*
27. Yellowthroated Sparrow, *Petronia xanthocollis.*
28. Whitethroated Munia, *Lonchura malabarica.*

Acknowledgements

We thank Chief Wildlife Warden of Rajasthan and staff of the DNP for their help.

Sighting of Eastern Calandra Lark, *Melanocorypha bimaculata (Blyth) in Kutch*

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The Eastern Calandra, Lark *Melanocorypha bimaculata* was sighted in Kutch by Himmatsinhji on 5 February 1960 on the mudflats near Bada village (Mandvi taluk). He saw several flocks (about 100 birds), of which one specimen was obtained (JBNHS 57:408). One specimen was collected by Dr Salim Ali in December ('Handbook', Vol.5, p.29). Himmatasinhji again came across *M.bimaculata* on January 10, 1966 near Sherdi village in an uncultivated field in Mandvi taluk. During periodic bird-density estimation of BNHS Grassland Ecology Project, Chhari-Phulay "Banni", I came across this lark on the following dates in 1992 :

1) November 27 — Census path I; 20 birds; at 15 meter distance; 8.17 hrs.; open grassland.
2) November 29 — Census path III; 1 bird; at 20 meter distance; 8.37 hrs.; open grassland.
3) December 30 — Census path II; 5 birds; at 35 meter distance; 8.20 hrs.; open grassland.

I had failed to see this bird during the BNHS Bird Migration Project in which I participated in and around the Charri dhandh in 1990–91.

Occurrence of *Ciconia episcopus* (Boddaert) in Kutch

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On November 23, 1992 I saw two Whitenecked Stork *Ciconia episcopus* at Tuga dam, Pachham Island, Kutch. The Whitenecked Stork is distributed practically all over India, but it seems to be extremely rare in Kutch. Ali (1945) did not come across it during his survey as also during his subsequent visits to Kutch. According to Roberts (1991) this stork is very rare in Pakistan and he does not make any mention of its recent occurrence in Sind, particularly lower Sind, just across the border with the Great Rann of Kutch. On the other hand Dharmakumarsinhji (1955) mentioned that it was found in Saurashtra.

The occurrence of the Stork in Kutch could only be termed accidental.

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Great White Pelican *Pelicanus onocrotalus* Linnaeus Recoveries from Kutch and Rajkot Districts of Gujarat

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The Great White Pelican Pelicanus onocrotalus Linnaeus is partly resident in Kutch, and was first discovered breeding in the Great Rann of Kutch in 1960 (Ali, 1960). It is mainly a winter visitor to Pakistan (Sind, Baluchistan) and north India.

In this note two ring recoveries are reported, one from Abdha Jheel in the Banni grassland, Kutch, and another from Paddhari village near Rajkot, Gujarat. Two more ring recoveries reported from Gujarat earlier by other workers are also included (Varu and Khatri, 1992). The details are given in Table-1.

I am thankful to Mr S.N. Varu for pointing out the news in 'Spanish', and to Dr A.J. Crivelli, Scientific Director, Statica Biologigue De la Tour Du Valat Le Sambuc 13200 Arles, Camargue, France who very kindly provided the details of recovery.

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Varu, S.N. and Khatri, M.B., 1992. Recovery of a Russian Ringed Rosy (White) Pelicanus onocrotalus Linn. in Kutch Gujarat. *J. Bombay nat. Hist. Soc.*, **89**(2) : 246.

Table 1

Sl. No.	Ring No.	Date of ringing	Place of ringing	Date of recovery	Place of recovery	Mode of recovery	Ring found by	Ring reported by
1.	Moskwa KK-0163	15-07-1982	Ily Delta Lake Balkash Kazakhstan 45.22N/74.08 P	February 1988	Kamleshwar Dam Gir W.L.S.	Found dead	–	Ravi Chelam
2.	Moscwa KK-2398	29-07-1990	-do-	10-11-1990	Medisar Reserved Forest Nirona Kutch	-do-	Ali Mohammad Manjothi Forest Guard	S.N. Varu & M.V.K. Khatri
3.	78 JC	09-07-1992	-do-	07-11-1992	Abdha Jheel in the Banni Grassland, Kutch	-do-	Mutva Saibana & Mizan	Author
4.	KK-3439	09-07-1992	-do-	26-02-1993	Jhilaria Pond Poddhari village near Rajkot	-do-	Caught alive by the villagers	Author

Conserving the Kole Wetlands - A Potential Ramsar Site from Southern India

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Introduction

Wetlands of Kerala are perhaps the least studied ecosystems ornithologically. This is evident from the literature. Studies on Kerala birds have a greater inclination towards the Western Ghats region (Hume, 1876, 1878; Ferguson, 1915a, 1915b, 1915c and 1916; Ali, 1935, 1969). The ornithology of Kerala wetlands started receiving attention after Neelakantan's extensive explorations, (Neelakantan, 1969, 1970, 1981, 1982; Neelakantan *et al.*, 1981; Neelakantan and Sureshkumar, 1981). Uthaman and Namassivayan (1991) did intensive study on the birdlife at Kadalundi estuary.. This study also came out with many interesting observations (Namassivayan *et al.*, 1989; Namassivayan (1992). However, studies on waterfowl got an impetus after the inception of the Asian Waterfowl Census (AWC)in 1987. The Kole Wetlands was practically unknown to the birdwatchers before the inception of AWC.

Location

The Kole Wetlands covering an area of 13,632 ha are spread over Thrissur and Malappuram districts extending from the northern bank of Chalakudy river in the South to the southern bank of Bharathapuzha river in the North. The area lies between 10°20é and 10°40'N latitudes and 75°58' and 76°11'E longitudes . The name Kole refers to the peculiar type of cultivation practice carried out from December to May. 'Kole', a Malayalam word, indicates bumper yield or high returns if floods do not damage the crop (Johnkutty and Venugopal, 1993). The rice cultivation in Kole had been started as early as 18th century after reclaiming the Thrissur *kayal* lands (backwaters) by erecting temporary earthern bunds.

Physiography

Physiographically the area is a product of fluvial estuarine agencies modified by human activities. The area consists of extensive flat land surface interspersed with uplands. Kole is saucer shaped with lowlands at the centre with elevation gradually increasing towards the fringes.

The Kole Wetlands are lowland tracts located 0.5 to 1m below msl. Major portion is flat and remains submerged for about six months. These were formerly shallow lagoons which gradually got silted up. The flood waters in Kole areas are mainly brought by two rivers, Kechery and Karuvannur which finally drain into the sea.

A network of main and sub canals connect the different regions of the Kole to the rivers. Being a flood plain, water level may rise as high as 5.5 m during peak south-west monsoon.

Climate

In the Kole region, the temperature varies from 21°C to 38°C, with high humidity. The area receives both south-west and north-east monsoons. The mean annual rainfall is 2757 mm.

Material and Methods

The avifauna of Kole Wetlands were monitored since 1989. In 1992 and 1993, comprehensive surveys have been undertaken. The observations are reported in this paper.

Results and Discussion

A total of 159 birds including passerines have been recorded from Kole Wetlands, out of which 30% are migrants (for a complete checklist see Nameer, 1992; Nameer, 1993). Sixty five species of waterbirds (in 13 families) and four migratory raptors have so far been recorded from Kole Wetlands (Table 1).

About 40% of the birds counted from Kole Wetlands belong to Laridae (eight species) followed by Ardeidae (24%; 13 species) and Anatidae (22%; six species). Though Charadridae has the maximum number of species (18) it accounts for only 8%. Podicipididae, Pelicandidae, Phalacrocoracidae, Ciconidae, Threskiornthidae, Rallidae, Jacanidae, Recurvirostridae and Glareolidae account for the rest 6% (Fig. 2).

The important families, based on the total number of birds seen, for the period 1989 to 1993 are given in Fig.3. This figure also showed that Anatidae, Ardeidae, Charadridae and Laridae are the important families at the Kole Wetlands.

Little Cormorant, Pond Heron, Cattle Egret, Little Egret, Redewattled Lapwing, Kentish Plover, Spotted Sandpiper, Green Sandpiper, Common Sandpiper, Little Stint, Temminck's Stint, Brownheaded Gull, Blackheaded Gull and Whiskered Tern have been recorded in all the five years at Kole Wetlands and could be considered as the commonest waterbirds.

Out of 159 species, 22 are not included in Birds of Kerala (Ali, 1969). They are Masked Booby, White Stork, Spoonbill, Pintail Duck, Comb Duck, Coot, Blackwinged Stilt, Oriental Pratincole, Grey Plover, Ringed Plover, Temminck's Stint, Sanderling, Herring Gull, Sandwitch Tern, Plain Sand Martin, Starling, Desert Wheatear, Black Redstart, Blackheaded Yellow Wagtail, Yellowheaded Wagtail and Red Munia. Except Comb Duck, Plain Sand Martin and Starling, other species have been reported earlier from other parts of Kerala (Ali, 1962; Gaston, 1979; Jairaj and Sanjeevkumar, 1990; Namassivayan and

Sivaprasad, 1981; Narayanakurup, 1989, 1990; Neelakantan, 1970; Neelakantan, 1982; Neelakantan and Sureshkumar, 1981; Sashikumar, 1990, 1991; Uthaman and Namassivayan, 1991).

Comb Duck (*Sarkidiorus melanotos*) was first seen on 17 January 1993 at Kole Wetlands (P.K. Uthaman, pers. comm.). There were four female birds. Three female Comb Ducks were again seen on 21 February 1993. There is no previous sight record of Comb Duck from Kerala.

Plain Sand Martin (*Riparia paludicola*) was seen on 10 January 1993 at Kole Wetlands (V. Santharam, pers. comm.). There is no prior sighting of this species from South India.

Starling (*Sturnus vulgaris*) is a migrant and has not been recorded from South India. Starling was first seen on 19 November 1988 at Kole Wetlands and its presence was later confirmed on 10 January 1993 (P.K. Uthaman, pers. commn.).

A Spotbilled Pelican (*Pelicanus philippensis*) was seen during the 1993 count (10 January 1993) which incidentally was the first sighting record after a gap of 77 years from Kerala. Later, a flock of 12 birds were seen on 15 January 1993 at Kole Wetlands.

Apart from Spotbilled Pelican, other endangered waterfowl viz. Oriental Darter, Watercock and Blackbellied Tern have also been reported from Kole Wetlands, out of the nine resident endangered waterfowl (Perennou, 1990) four were seen from Kole Wetlands.

A tern roost has been located at Kole Wetlands, where nearly 25,000 terns were counted. This may be one of the largest tern roosts in the country.

Conservation

Kole Wetlands is one of the largest and most important wetland of Kerala and is also the most threatened wetlands in the State. Reclamation of land and change in land use pattern are the most serious problems. The paddy fields are being converted to coconut, arecanut, and banana plantations and other cash crops at an alarming rate. The marshes are being 'developed' and new constructions are cropping up. At many places the wetland has been converted to brick-kilns, which has become a profitable small scale industry. Added to this, large scale poaching and trapping of birds and fishing are also going on. Out of the 12 pelicans seen on 15 January 1993, two were killed by the poachers.

The indiscriminate use of pesticides has been found to affect the migrant bird population which visit Kerala wetlands from September to April. The pesticides besides affecting the birdlife indirectly, were also being usedas bait poisons to capture edible birds. Besides, setting fire to the natural vegetation is also adversely affecting the breeding habitats of Rallidae, Sylviinae, Ploceinae and Estrildinae.

The avian community not only plays an important role in controlling insect pests and other harmful organisms but also increases the fertility status of the soil through their droppings. Unless immediate measures are taken there could be a series of ecological, economical and social problems.

Recommendation

Since Kole Wetlands satisfies most of the Ramsar Convention Criteria (viz., Criteria 1, 2a, 2b, 2c, 3a, 3b, 3c; Rose, 1990) it deserves the status of a Ramsar Site, which if granted,Kole will be the first Ramsar Site from South India.

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Table 1 : Population trend of avifauna at kole wetlands from 1989 to 1993

Sl. No.	Family/Species	1989	1990	1991	1992	1993	Total
	PODICIPEDIDAE						
1.	Little Grebe	–	–	2	38	18	58
	PELECANIDAE						
2.	Spot-billed Pelican	–	–	–	–	1	1
	PHALACROCORACIDAE						
3.	Indian Shag	–	–	–	–	4	4
4.	Little Cormorant	21	4	10	263	390	688
5.	Oriental Darter	–	–	–	2	6	8
	ARDEIDAE						
6.	Black Bittern	–	–	2	2	2	6
7.	Yellow Bittern	–	–	4	–	–	4
8.	Chestnut Bittern	–	–	8	–	–	8
9.	Night Heron	–	–	–	6	7	13
10.	Pond Heron	1020	310	750	2495	1406	5981
11.	Cattle Egret	4	18	10	4248	112	4392
12.	Little Green Heron	–	–	–	2	1	3
13.	Reef Heron	–	–	–	7	–	7
14.	Little Egret	503	127	450	1385	2770	5235
15.	Intermediate Egret	–	65	1100	93	606	1864
16.	Great Egret	–	50	110	18	67	245
17.	Purple Heron	–	2	2	9	32	45
18.	Grey Heron	–	–	–	13	4	17
	UI ARDEIDAE	1	–	–	2537	1546	4084
	CICONIDAE						
19.	Openbilled STork	–	43	–	161	11	215
20.	Whitenecked Stork	–	–	–	4	12	16
21.	White Stork	3	–	–	–	–	3
	THRESKIORNITHIDAE						
22.	White Ibis	–	–	1	26	–	27
	ANATIDAE						
23.	Lesser Whistling Teal	–	50	30	100	5350	5530

Sl. No.	Family/Species	1989	1990	1991	1992	1993	Total
24.	Comb Duck	–	–	–	–	336	336
27.	Gargany	–	1500	250	–	7887	9637
28.	Common Teal	–	–	20	–	–	20
	RALLIDAE						
29.	Ruddy Crake	–	–	–	2	2	4
30.	Whitebreasted Waterhen	–	25	60	22	4	111
31.	Watercock	–	–	–	1	–	1
32.	Indian Moorhen	–	–	–	1	–	1
33.	Purple Moorhen	–	–	–	7	268	275
34.	Coot	–	–	9	2	–	11
	JACANIDAE						
35.	Pheasant-tailed Jacana	–	–	6	2	82	90
36.	Bronzewinged Jacana	–	–	10	1	5	5
	RECURVIROSTRIDAE						
37.	Blackwinged Stilt	6	33	130	68	–	237
	GLAREOLIDAE						
38.	Little Pratincole	–	93	100	1085	42	1278
39.	Oriental Pratincole	–	–	10	–	–	10
	CHARADRIDAE						
40.	Redwattled Lapwing	31	20	25	50	30	126
41.	Golden Plover	264	–	100	205	352	921
42.	Ringed Plover	–	–	–	2	–	2
43.	Littleringed Plover	42	–	520	241	724	1527
44.	Kentish Plover	13	21	150	6	58	248
45.	Lesser Sand Plover	20	20	–	15	111	166
46.	Large Sand Plover	–	51	25	–	–	76
47.	Curlew–	–	–	21	–	21	
48.	Redshank	–	2	25	1	–	28
49.	Marsh Sandpiper	10	–	10	32	2	54
50.	Greenshank	–	10	25	13	13	61
51.	Green Sandpiper	32	–	150	132	44	359
52.	Spotted Sandpiper	15	34	150	421	579	1199
53.	Common Sandpiper	47	34	210	173	26	490
54.	Pintail Snipe	–	–	–	5	–	5
55.	Common Snipe	–	4	1	17	1	22
56.	Little Stint	9	25	400	287	200	921
57.	Temminck's STint	11	21	120	42	103	297
	LARIDAE						
58.	Lesser Blackbacked Gull	–	–	–	–	95	95
59.	Brownheaded Gull	19	4	2	7	250	282
60.	Blackheaded Gull	480	20	200	1599	28	2327
61.	Whiskered Tern	143	20	210	2642	10000	13015
62.	Gullbilled Tern	331	–	225	4	5000	5560
63.	Caspian Tern	–	–	–	–	16	16
64.	Little Tern	–	–	4	–	–	4
65.	Blackbellied Tern	–	–	–	–	1	1
	ACCIPITRIDAE						
66.	Marsh Harrier	–	–	–	16	16	32
67.	Pale Harrier	–	–	–	2	1	3
68.	Pied Harrier	–	–	–	2	–	2
69.	Osprey	–	–	–	1	2	3
70.	Brahminy Kite	–	–	–	–	58	58

Fig 1. Distributation of Important Families at Kole Wetlands

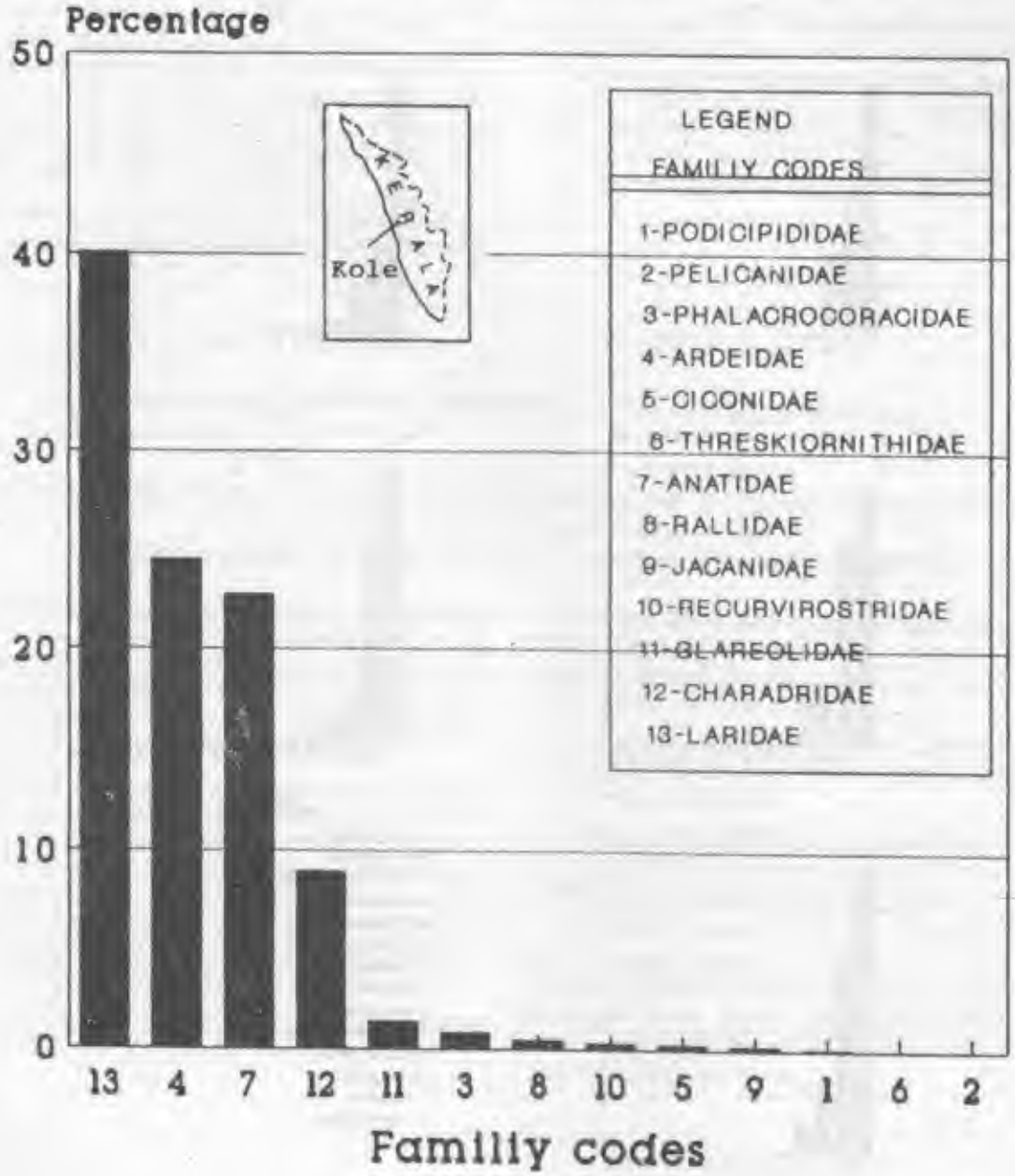
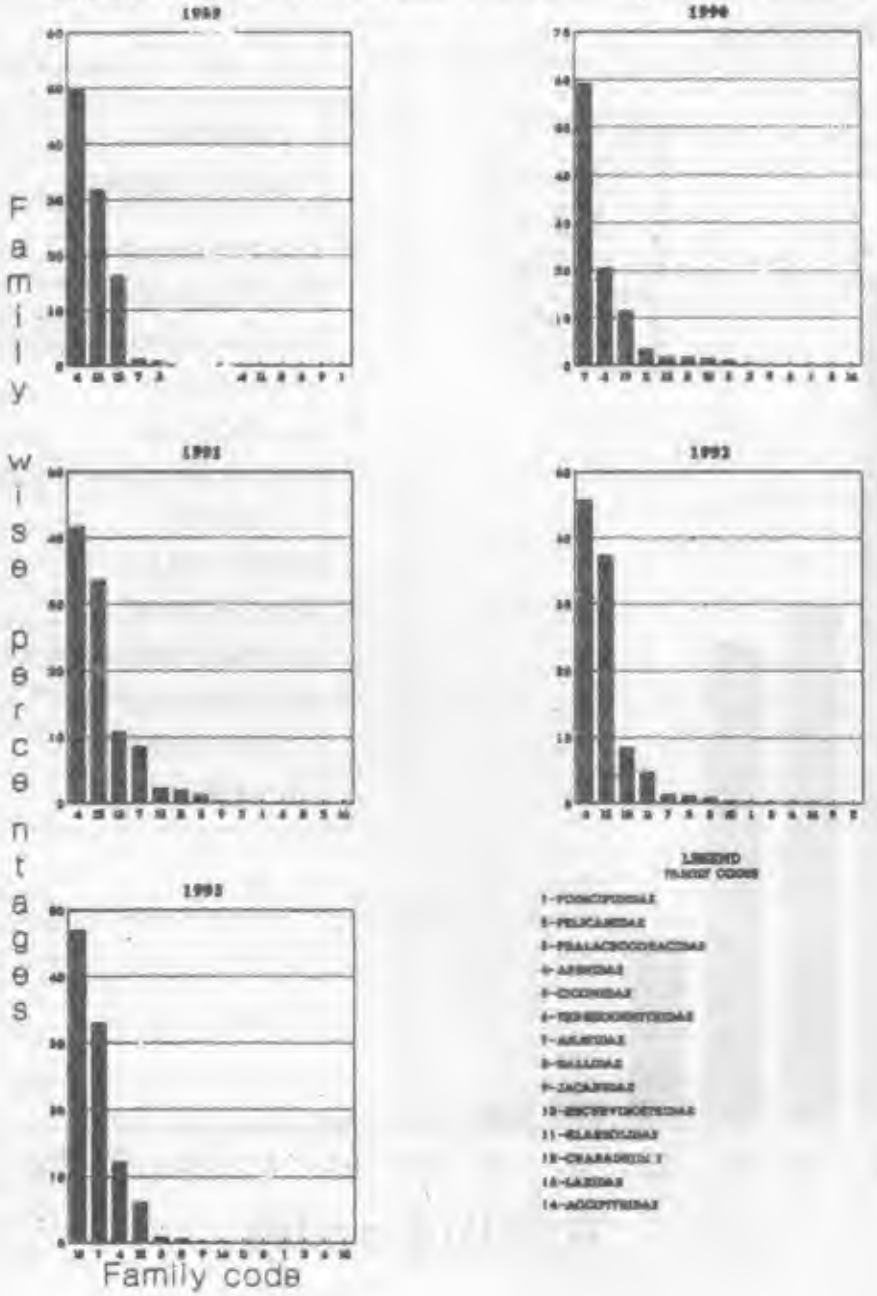


Fig. 2. Year-wise Distribution Pattern of Important Families



Bird Mortality on Roads in Punjab

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Many birds frequent roads for feeding on spilled grains or dead animals or for other purposes and are exposed to mortality from vehicles. From 1989 to 1991, we conducted 138 surveys covering a total road length of 7304 km in Punjab to record roadside bird mortality. While travelling in a jeep or car at 50 to 60 Kmph, we counted all birds found killed on the road and its sides.

An total of 399 birds belonging to 27 species were found killed on the roads surveyed. Mortality was the highest in Whitebacked Vulture, *Gyps benghalensis*(29.3% of total kills) followed by House Crow, Corvus splendens (26.1%). The other species often killed on roads included Common Myna, *Acridotheres tristis* (6.5%), Ring Dove, *Streptopelia decaocto* (5.8%), House Sparrow, *Passer domesticus* (5.0%), Crow Pheasant, *Centropus sinensis* (3.5%), Barn Owl, *Tyto alba* (2.3%) and Pied Myna, *Sturnus contra* (2.3%).

Status and Habitat Requirement of Yellowthroated Bulbul

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Yellowthroated Bulbul, *Pycnonotus xantholaemus* Jerdon a species endemic to South India is one of the least studied species with virtually no information on its status, habitat requirement and threats and disturbances to its survival. keeping this in view the information gathered from a survey of 26 localities has been presented.

Yellowthroated Bulbul was principally seen on boulder strewn hills with vegetation ranging from southern tropical thorn scrub, dry deciduous forest to moist deciduous forest. From a comparison of hills where Yellowthroated Bulbul was recorded with those where the species was not recorded, it was evident that total denudation of vegetation and quarrying were the two most serious factors leading to the local extinction of the species through habitat loss.

Observation on the feeding habits of Yellowthroated Bulbul indicated that the species fed predominantly on berries and significantly a great majority of berries were taken from shrubs than trees. Yellowthroated Bulbul adopted different foraging methods to capture insects, depending on the type of vegetation.

The survey of indicated that the species is highly tied to hill habitat. Only on two instances it was observed to stray from the base of the hill.

Of the major threats to the habitat, wood-cutting ws rampant, hillocks were being quarried at many places and cattle grazing on hill vegetation was observed.

The survey revealed that though Yellowthroated Bulbul is not threatened within its habitat, destruction of vegetation on which it depends and the quarrying activity leads to local extinction of the species. Considering this, there is an urgent need to identify potential habitats and protect them against habitat destruction.

Effects of Industrialisation on the Populations of Peafowl, *Pavo cristatus* Linn

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The 14 km stretch between Kovilpalayam and Annur on the Coimbatore-Sathyamangalam road is a typical peafowl country with a semiferal peafowl population inhabiting a semiarid and partially wooded agroecosystem. The continuous cropping of sugarcane, cotton, groundnut, vegetables, groundnut and millets offer ideal habitat and regular supply of food to these birds. The pest and non pest insects and other arthropods associated with various crops also provide food to peafowls. The absence of any significant predators and protection by a friendly and religious farming community helped peafowls to flourish here. Foraging flocks of peafowls could be sighted here.

With the government subsidised rapid industrialisation commencing from 1986, there started the 'habitat disturbance' in this area. Hence a regular survey was initiated from March 1986, to study impact of industrialisation on the populations of peafowl and breeding activities.

Material and Methods

Four counting points were selected on the 14 km stretch on the Coimbatore-Sathyamangalam state highway from Kovilpalayam. These included Kunnathur, Telugupalayam, Ganesapuram and Kariyampalayam. These observation posts were visited four times each during March, June, September and December every year between 1986 and 1992. The total population of peafowls including males, females and juveniles were estimated from 0630 hrs to 0830 hrs in the morning and 1630 hrs and 1830 hrs in the evening. The number of industrial units were also estimated in this area annually from 1986 onwards. The data are given in Table 1.

There has been a steady decline in the population throughout the period of observation. The reduction was progressive starting with 15.91% in the first year and reaching to 68.18% after six years along with the progress of Industrialisation. The severe reduction in the loss of juvenile population indicates decline in breeding activity.

The major reason that could be attributed to this decline is the loss of habitat. With more and more industrial units coming into existence, the area of farm lands rapidly declined.

The peafowl is not a shy bird with reference to the proximity of human beings particularly in villages where it is considered as sacred (Dharmakumarsinhji and Lavkumar, 1981 and Thirumurthi *et al.*, 1981). The increased human activity due to industrialisation could have affected the population only marginally. The habitat destruction in the form of reduced shelter by canopy destruction and tree felling as well as the dwindling food supply on the other hand drastically affected these birds.

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Table 1 : Effect of industrialisation on population reduction in peafowl

Year	No. of industrial units	Peafowl population	% reduction
1986	8	176	–
1987	13	148	15.91
1988	18	132	25.00
1989	22	122	36.68
1990	26	116	34.01
1991	37	100	43.18
1992	49	56	68.18

Education Through Bird watching

Prashanth Hebbar

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Introduction

With education being commercialised, this is an attempt to find various ways to restore the ethics of education and the spirit of learning.

The process of learning takes place only when the environment in which the teacher-student interactions take place is natural, pleasant and lively. In a typical class room session we seldom come across such an environment. A birding session brings the teacher and student more closer and the environment will be perfectly conducive for learning processes.

In order to systematize the process of learning, we have enforced division in the flow of information like Physics, Chemistry, Mathematics, Biology, etc. and the knowledge acquired by the child is thus bifurcated into innumerable subjects. The child grows up with this division in mind and any event it perceives will be catagorised as above. This paper looks at one of the methods to avoid such divisions.

Look at any child today, the strain of enforced education is very much evident on his face. This is certainly not the aim of education. This paper makes an attempt in making the process of learning more lively and enjoying.

P.S. : Please note that the method propounded here is not a substitute for class room teaching.

A Routine Class Room Session Vs A birding Session

Scene A: The Class Room

The class room is overflowing with students. The teacher is trying his best to draw their attention to the almost white black board. The heading "Sets" is hardly visible but the students are least bothered since they are busy in their world. A handful of the students are taking down whatever the teacher writes on the board. After fortyfive minutes the whole class room reverberates with an ear-piercing ohh..... The teacher stumbles out of the class room with the 'operation-success-but-the-patient-died look on his face'.

Observation

The teacher - student relation is formal and distant. The environment is unnatural, unpleasant and unfit for transacting knowledge.The student attention is almost zero and the subject being taught is merely looked upon as syllabus for examinations.

Scene B: Country side

A teacher and his assistant have brought some students to a small vegetation patch on the outskirts of the city. The students are divided into two groups each of which take two different paths. One group is accompanied by the teacher while the other is joined by his assistant. The students are equipped with notebooks and are busy noting down their observations. The whole operation looks so clinical that it is apparant that the students have been briefed about the birding session prior to this. After nearly an hour's walk the two groups join again in a predetermined point. The students are excited, happy and a look of satisfaction is dancing on their faces. Shortly the teacher has made the students to sit under a tree and is collecting the names of birds recorded by each group. He calls the two lists compiled by the two groups as "Set A" and "Set B". Thus methodically without giving an impression that he is teaching a part of the syllabus the teacher has started his lesson on "Sets". He prompts the students to identify birds common to both the lists (Sets) and make a separate list, which he calls the "Intersection of two sets". Like wise he makes the students to form the "Union of two Sets". After nearly two hours they have started back to their school.

Observation:

Scene B is self explanatory. It has succeeded in avoiding all the loopholes of scene A. We can also see that the students are made to take a prominent part in the process of learning by using the data collected by the students themselves. The teacher has merely set a platform wherein there is free flow of information.

Why Choose Birdwatching Session as an Educational Medium ?

Birds can be watched under natural conditions with least investment.

Children always love being out-doors. Infact they learn a lot while doing out-door activities. This is because the natural world around them makes them curious and the faculty of inquiry is thus developed which is vital in anyone's growth.

The mere process of spotting a bird and identifying it brings immense feeling of acheivement and satisfaction and prompts the child to learn more.

Birding can be done either individually or in groups. Neverthless it develops the confidence and inculcates the spirit of team work.

Bird watching demands a high degree of patience, concentration, and the ability to observe.

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Methodology and approach

Birdwatching itself will not teach anything unless and untill one endeavours to interpret the observation he has done in his birding trail. Birding is an effective tool for teaching but is not a substitute for classroom teaching. A teacher who plans to use bird-watching as a tool to communicate some part of the syllabus to the students can adopt two approaches namely

(i) Project work

(ii) Short birding sessions

The project work is a long-time programme for which the teacher will have to plan in advance and chart out the activities to be done. This will be done in consultation with the academic syllabus of the target students. The target students can then be divided into small groups and assigned specific projects.

The project work can be divided into

a) Studies/observations

b) Practical work like building nest, water baths, hides, etc.

It is advisable to have a combination of both (a) & (b) to make a project balanced. If desired and possible 'documentation' can be taken as a part of the project wherein the students are made to photograph birds and/or record the bird calls.

Short birding sessions can also be effective if handled intelligently. I here warn the teacher that his experiment in adopting this method may fail if he takes the students out only once.

The teacher might find it necessary to have one to two pre- birding sessions in which he can give hints to the students as to what to look for when they are birding.

If the teacher is taking a group on a birding session for the first time, it is advisable not to use that session for his teaching purposes. A few sessions have to be conducted so that the students can acquaint themselves with the ways of nature.

Examples

1. To study how and why a bird sits in a particular posture is very interesting. Different birds have different sitting postures and in many cases a bird can be identified to be belonging to a particular family by its silhoutte. A subtle information that one can grasp through some thinking is the reason behind a bird's particular posture. consider a kindfisher which sits almost vertically (upright). This posture helps the bird to maintain its balance. If it were to adopt any other posture it would topple over because of its heavy, stout beak. A dove on the other hand sits almost horizontally. Doves have a comparitively long body which means that to balance itself it will have to sit almost horizontally. The teacher can take such opportunity to teach his/her pupils about 'centre of gravity'.

2. The topic 'motion in a plane' is so heavywith theory that seldom do the students pay attention to what the teacher is saying in the classroom. The same topic can be made more lively and interesting by a walk in a garden or a park.

   Ask the students to observe any bird flying around in the near surrounding from one identifiable point to another (say from a fence post to the roof of a building). Now let a group of students estimate the distance between the two points and the other group estimate the time take by the bird(s) to cover this distance. This can be repeated several times with other birds. When they fill the table below

   They will have in their hands a treasure of scientific data which can be utilised by the teacher to introduce concepts like Speed,Velocity and Acceleration.

3. Birds are unique by virtue of their ability to fly. The flight of birds are based on sound aerodynamic principles. A teacher can use a birdwatching session to introduce the 'Bernouli's Principle' to the students. During the birding session he can draw the attention of the students to the flight of various birds. Later in the post-birding session the teacher can talk about 'Beroulli's principle'.

4. Often we see vultures and kites soaring very high in the sky in large circles for a long time without once flapping their wings. The teacher can use such sights to teach the students about 'Thermals', its origin and related concepts.

5. Say a bird is perching on top of a post. The teacher can immediately initiate the students in estimating the height of the post. This will be an ideal situation to introduce the concept of 'Mensuration' and the teacher can adopt the crude mensuration method using the principle of isoceles right angled triangle. Thus the concept of Isoceles triangles can also be taught.

This will I hope restore that dimension of Education, which has been long forgotten by us, wherein 'nature' is used as an effective tool for teaching.I have given here just a few examples which gives an idea of the potential of using birdwatchng sessions to teach regular topics from the school syllabus. The fact that I have taken the examples to illustrate concepts of Physics and Mathematics which are normally considered the most difficult to teach and most dreaded by the students, does not mean that only these subjects can be taught. Birdwatching sessions can be used to teach any subject through some innovative thinking.

AERODYNAMICS OF BIRD FLIGHT

A. As the wing is tilted upwards, lift increases & smooth air flow induces flight. The aerofoil wing section decreases drag.

B. But a sharp tilt induces turbulance

C. The Alula or 'Bastard Wing' smoothens air flow around the wing.

THERMALS

A. Rise of hot air.

B. Cold air undercuts hot column

C. A hot bubble forms and rises

D. A Raptor rides (Soars) effortlessly on the rising bubble

Habitat Quality Estimation by Habitat Suitability Index in *Metopidius indicus*

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Introduction

Habitat quality can be numerically described on the basis of Habitat Suitability Index (HSI), for selecting the appropriate site suitable for the species (USFWS, 1980) and can be recommended for management programme. Allen (1985, 1986) had successfully applied HSI on American Coot and Mallard. Comparative study of the habitat quality of residential bird species has not been emphasized from conservation point of view in North East India. The present work with *Metopidius indicus* was taken up to assess the feasibility of the method in regional context.

Material and Methods

Studies of habitat quality estimation were carried out in Gauhati University Campus (27° 11' N and 91° 47' E). Five different wetlands were selected (Table 1).

McCuen and Whitaker (1975) analyzed wild-life habitats by inventorying the major components giving each a value and weighing its relative importance to groups of wild-life species. Index value for each wetland component found within the home range of the species is then proportionized according to other components of the wetlands. The overall value for wetlands is derived by totaling all the proportionized value (Allen, 1985, 1986).

The required information recorded were as follows :

a) Population was recorded each day for the whole study period covering all the durnal period.

b) Vegetation coverages of each habitat was estimated by simple observation.

c) Foods were identified in the field by direct observation and with the help of literature (Ali and Ripley, 1983).

d) Edge index of different wetlands were estimated following the standard method (USFWS, 1980).

e) Water conditions of different wetlands were estimated from the past records and present observations.

f) Water depths and vegetation heights were measured.

The whole study was done between September and December, 1992.

Results and Discussion

Populations

Based on population numbers in different wetlands, Wetland-I was found to be the most suitable (Table 2).

Vegetation Coverage

Amongst the five wetlands, Wetland-I is well composed (Table 1, Fig 1). Cover preferred by *M.indicus* is mainly *Hymanachancae* sp. and *Eichhornia* sp. Nests were present only when vegetation was found beyond 60 per cent.

M.indicus preferred the vegetation height between 0.5 to 3.5 feet, where the nest were camouflaged.

Wetland-I comprised of mostly vegetation between 0.5 to 3.5 feet (Fig.2).

Food

In the present study following food items were identified for *M.indicus*.

i) Roots and flowers of *Hymanachancae* sp. (Family: Poaceae)

ii) Chara (Family: Ceratophyllum)

iii) Roots of *Salvinia cuculata* (Family: Salviniaceae)

It was observed that roots and flowers of *Hymanachancae* sp. were mostly preferred. Mollusca (*Lemnae* sp., *Planorbis* sp.) and Coleopterans (*Cassida circumdata*) were identified as food for *M. indicus*. Food preference was 75 per cent vegetation and 25 per cent animal food in non-breeding season, while animal food was preferred during breeding season (June to September). Vegetation utilization preference of *M.indicus* as food and cover indices are given in Table No.3, Fig. No.3.

Edge Index

Edges of vegetation are mostly used by *M.indicus* for feeding, resting, calling and nesting. It was observed that suitability indices of each wetland increased with respect to the increase of edge index (EI) except in Wetland-IV (Wetland-IV was a highly disturbed zone) (Table 4 and Fig 4).

Water was also a major independent variable which determined the habitat quality of *M.indicus*. Water quality was found to be most suitable in Wetland-I for *M.indicus* than other four wetlands (Table 4, Fig 4).

Habitat Suitability Index (HSI)

M.indicus is a residential bird and it used the same habitat for feeding and nesting. The suitability of habitat for *M.indicus* mostly depended upon food availability and breeding requisites.

In the present study it was found that SIV1, SIV2 and SIV3 are the main fundamental variables where the former

two are dependent and the latter is independent variable. The quality of these variables ultimately determined the suitability of the habitat for *M.indicus*.

In Wetland-I, SIV2 is equal to 1.0 (Table 4) and SIV3 is also 1.0 (Table 5). For different SIV1 value (Table 3) the HSI value of Wetland-I for *M.indicus* was as follows :

For Mymanachanae sp.	$HSI = (1.0 \pm 1.0)^{1/2}$	= 1.0
Salvinia sp.	$HSI = (0.8 \pm 1.0)^{1/2}$	= 0.89
Nymphaea sp.	$HSI = (0.6 \pm 1.0)^{1/2}$	= 0.77
Scripus sp.	$HSI = (0.4 \pm 1.0)^{1/2}$	= 0.63
Eichornia sp.	$HSI = (0.2 \pm 1.0)^{1/2}$	= 0.44
Merrimia sp.	$HSI = (0.0 \pm 1.0)^{1/2}$	= 0.00
		= 3.73

So the value for Wetland-I [HSI = (3.73/6)] = 0.62

Thus the value of different wetlands are tabulated in Table 6.

From the practical point of view 100 percent suitability of habitat (HSI = 1.0) for any wild life species is never expected. Different rank may be given to different wetlands for its suitability (Table 7).

The vegetation specificity (used as food and cover) edge and the water quality were the determining variables, that influenced the quality of the wetlands as a habitat for *M.indicus*. Allen (1985) opined that the non-migratory species of water-birds depends upon the degree of interspersion of essential habitat types because this determines the amount of edges. *M.indicus* preferred *Hymanachanae* sp. as food as well as cover. But for selecting the nest building site it always preferred the site with *Nymphaea* vegetation surrounded by *Hymanachancae* sp.

The habitat change which are expected along with the change of season or because of any major contribution of an abiotic factor is within the purview of the species habitat requirements. Hence the species may shift to the most suitable wetlands to maximise the available advantages provided by nature.

For conservation, detecting the limiting factors is basic to habitat management. A complete understanding of the processes of habitat formation would be desirable. This study would help in the required modification of habitat for the protection and conservation.

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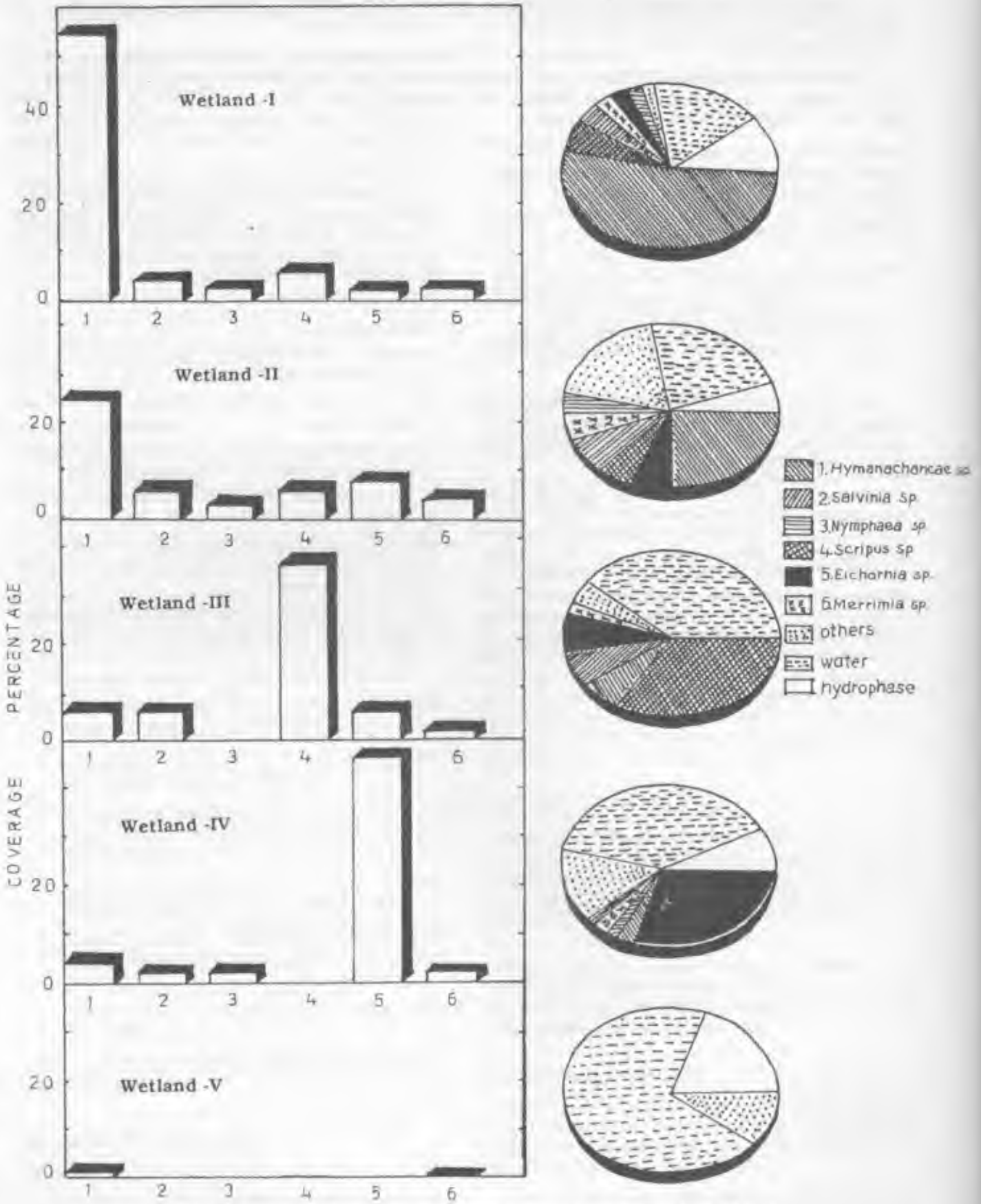

Fig.1. Coverage of different species of plants in the time zones (Data from Table 1).

Table 2. Vegetation coverages against vegetation height in different wetlands

Wetlands	I	II	III	IV	V
Total area (Hec.)	4.42	2.26	1.74	0.28	0.59
Total vege. coverage	72.5%	70.0%	60.0%	67.5%	10.0%
Actual water	17.25%	25.5%	40.0%	25.85%	72.0%
Hydrophase	10.25%	4.5%	0.0%	6.65%	18.0%
Nymphaea sp.	2.72%	2.8%	0.0%	1.62%	0.0%
Hymanachanae sp.	54.36%	24.5%	6.0%	3.36%	1.0%
Scripus sp.	5.8%	6.58%	36.0%	0.0%	0.2%
Merrimia sp.	2.9%	3.78%	1.6%	1.69%	0.7%
Salvinia sp.	3.44%	6.16%	6.0%	1.01%	0.0%
Eichornia sp.	2.54%	8.05%	6.0%	47.25%	0.0%
Jussieua sp.	0.73%	0.7%	3.0%	0.68%	0.0%
Ceratophyllum sp.	0.0%	0.0%	0.0%	7.43%	8.0%
Fern	0.0%	0.0%	0.0%	3.38%	0.1%
Alternanthera sp.	0.0%	0.7%	1.2%	1.01%	0.0%
Arm sp.	0.0%	0.98	0.0%	0.0%	0.0%
Oriba sp.	0.0%	16.38%	0.0%	0.0%	0.0%

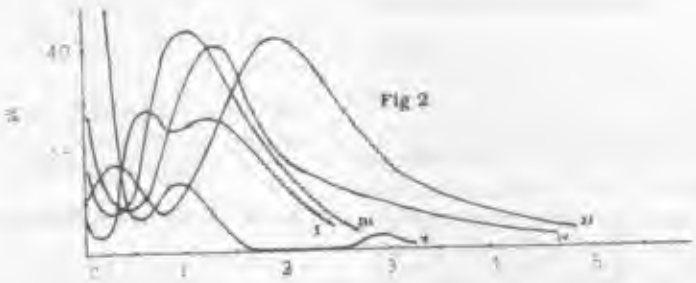

Fig.2. Vegetation coverages against vegetation height in different wetlands.

Table 2. Population of M. indicus in different wetlands and suitability index.

Wetlands	I	II	III	IV	V
Avr. population	17.7	11.2	6.3	2.9	0.1
Suitability Index (SI)	1	0.7	0.5	0.3	0.01

Table 3. Suitability index against vegetation preference.

Sl.No	Vegetation	Suitability index
1.	Hymanachancae	1.0
2.	Salvinia	0.8
3.	Nymphaea	0.6
4.	Scripus	0.4
5.	Eichornia	0.2
6.	Merrimea	0.00

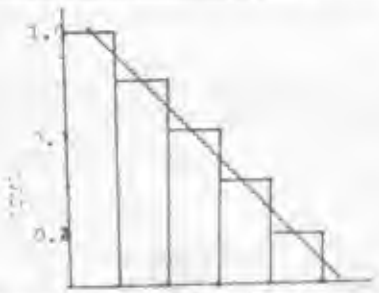

Fig.3. Suitability index against vegetation preference

Table 4. Edge index of different wetlands

Sl.No	Wetland	Edge index (DI)	Suitability Index (SIV2)
1.	I	0.3594204	1.0
2.	II	0.3388937	0.7
3.	III	0.2502763	0.5
4.	IV	0.490	0.3
5.	V	0.007001	0.0

Table 5. Water suitability of different wetlands

Sl. No.	Wetland	Suitability index given (SIV3)
1.	I	1.0
2.	II	0.75
3.	III	0.50
4.	IV	0.25
5.	V	0.00

Table 6. HSI values (calculated) of different wetlands

Wetlands	I	II	III	IV	V
HSI	0.62	0.40	0.22	0.09	0.00

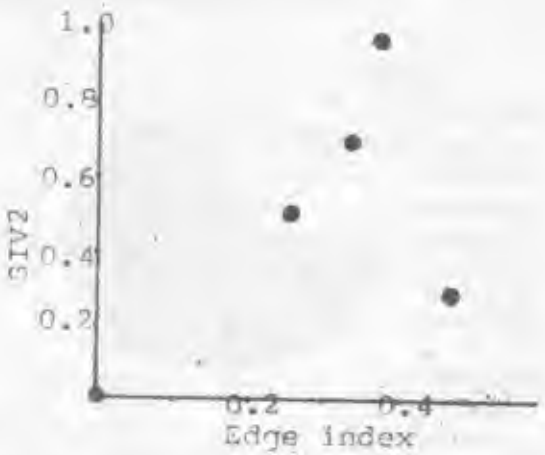

Fig.4. Relationship between suitability and edge index.

Fig.5. Relationship between SIV3 and water regime.

Table 7. Ranking of different wetlands

Sl. No.	Wet-lands	HSI	Ranks
1.	I	0.62	BEST (HSI = 1 to 0.62)
2.	II	0.40	GOOD (HSI = 0.59 to 0.40)
3.	III	0.22	BAD (HSI = 0.39 to 0.20)
4.	IV	0.09	NOT SUITABLE (HSI = 0.19 to 0.00)
5.	V	0.00	LEAST SUTIABLE

A Study on the Habitat Quality of *Dendrocygna javanica* Horsfield

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Introduction

Dendrocygna javanica Horsefield (Lesser Whistling Teal) is the most successful species among the six residential species of Anatidae in Assam and the Whitewinged Wood Duck (*Cairina scutulata*), is the most endangered duck. The high adaptability of *D. javanica* with the changing habitat conditions prompted this study on its habitat quality. The present study is mainly concentrated on the reproductive habitat of *D. javanica*. The structural and physical features of a habitat are measurable and habitat quality can be evaluated. Thus, this study will also support conservation efforts.

Material And Methods

Five different wetlands with similar physiography and vegetation quality were selected in the Gauhati University Campus (26° 11' N and 96° 47' E) for the detailed habitat analysis: (1) Zone A (4.42 ha), (2) Zone C (2.62 ha), (3) Zone E (1.47 ha), (4) Zone F (0.28 ha), (5) Zone P (0.59 ha).

The period of investigation was October and November which is late breeding period of *D.javanica*. During the period the following suitable conditions were found :

a) Water level was reasonably high

b) The young ones were found with the parents and a distinct parental care was evident

c) Good vegetation.

Habitat Suitability Index (HSI) Model (Anonymous, 1981 a,b,c) is a numerical index. If minimum value of HSI is 0.0 it will be considered unsuitable and a maximum value of 1.0 represents optimum suitable habitat. Three variables which are essential to evaluate the suitability index were : 1) Vegetation cover type percentage (SIV_1) : The cover percentages of dominant herbaceous plants were evaluated by simple observation considering the total vegetation as 100%. 2) Edge index (SIV_2) : It was computed by the following formula

$$DI = \frac{l}{2\sqrt{A\pi}}$$

where l = length of edge of wetland boundary and emergent vegetation
A = Area of wetland covertype
DI = Edge index

and 3) Water regime (SIV_3):The characteristics of flooding condition of every studied zone were observed and categorized. The values of every components of all SIVs were given arbitrarily in natural number according to their importance in relation to the suitability of the habitat.

Suitability index for habitat composition (SIHC)

$$SIHC = \frac{A}{\Sigma R}$$

where R = Least amount of vegetation covertype which supports the presence of least number of *D.javanica*

$$A = \frac{\text{Individual vegetation \%} \times 100}{500 \text{ (for 5 zones)}}$$

HSI Determination

$HSI = RSI = (SIV_1 \times SIV_2)^{1/2} \times SIV_3$ Where RSI = Reproductive suitability index.

Dependable variables SIV_1 and SIV_2 are modified by independable variable SIV_3. Number of *D.javanica* was counted per wetland zone.

Results And Discussion

Population of *D.javanica* was found highest in the zone – A and lowest in the zone – E (Table 1). Study of relationship between the dominant species of vegetation and the number of *D.javanica* revealed that in composite wetlands where large amount of *Hymanachanae* sp. with considerable amount of *Nymphaea* and *Scripus* sp. were present (height of the vegetations ranged between 0.5 feet to 3 feet above the water level) the number of *D.javanica* was found to be the highest (zone A). On the other hand teals were not found in the wetlands covered with maximum amount of water hyacinth (zone E).

Determination of suitability index for habitat composition (SIHC) was based on some essential vegetation cover-type (Table 2 and Fig.1). The edge index suitability ranged from 0.25 to 0.50 with the most suitable edge index (0.36 approximately) in zone A (Table 3 and Fig.2).

The perennially flooding condition is comparatively better for the breeding of *D.javanica*; while intermittently flooding condition seemed to be unsuitable (Table 4).

HSI Evaluation

Suitability indices of three variables were put in the following equations to evaluate the HSI values zone-wise :

$HSI = (SIV_1 \times SIV_2)^{1/2} \times SIV_3$

For zone A, $SIV_1 = 1$, $SIV_3 = 1$

i) SIV_1 for *Hymanachanae* sp. = 1

$\therefore HSI = (1 \times 1)^{1/2} \times 1 = 1$

ii) SIV_1 for *Nymphaea* sp. = 0.8

$\therefore HSI = (0.8 \times 1)^{1} \times 1 = 0.89$

iii) SIV_1 for *Scripus* sp. = 0.6

$\therefore HSI = (0.6 \times 1)^{1/2} \times 1 = 0.78$

iv) SIV_1 for *Salvinia* sp. = 0.4

$\therefore HSI = (0.4 \times 1)^{1/2} \times 1 = 0.63$

v) SIV_1 for *Merrimia* sp. = 0.2

$\therefore HSI = (0.2 \times 1)^{1/2} = 0.45$

vi) SIV_1 for *Eichhornia* sp. = 0

$\therefore HSI = (0 \times 1)^{1/2} \times 1 = 0.0$

$\therefore$ Total HSI = 3.75

$\therefore$ HSI for Zone A = 3.75 ÷ 6 = 0.625

The values of HSI of other studied zones are listed in Table 5.

The present study was done during the late breeding period of *D.javanica*; hence only the suitability of reproductive habitat was considered. It can be assumed that *D.javanica* preferred composite wetland as reproductive habitat having different types of water vegetations distributed evenly throughout the wetland with open water in the ratio being approximately 70 : 30. It preferred mostly *Hymanachanae* grass and *Nymphaea* with the height of 0.5 to 3 feet above the water level. This finding agreed with the observation of Ali and Vijayan (1986). The presence of compactly distributed water hyacinth does not contribute to the suitability of reproductive habitat of *D.javanica*.

Large number of teals counted in the Zone P, was due to the fact that the site was used for resting as highland bank area and tall *Merrimia* sp. (Shrubs) provided good cover.

D. javanica is found to co-exist with other compatible wetland avifauna. Though it is a successful residential wetland teal, this study has revealed that some factors contributed to the deterioration of habitat quality.

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4. ———, 1981 c. 103 ESM U.S. Fish and Wildlife Services Transmittal sheet.

Table 1: Number of *D. javanica* per wetland zone

Zone	A	P	C	F	E
Average No. of individuals	204.7	48	17.5	0.8	0

Table 2. Determination of suitability index for habitat composition (SIHC) and SIV_1

Sl.No.	Vegetation cover type	Recommended minimum % comnposition of cover type (R)	Optimal habitat composition index $\left(\frac{R}{\Sigma R}\right)$	Actual % of composition of cover type (A)	Actual habit composition SIHC = $\frac{A}{\Sigma R}$	SIV_1
1	*Hymanachanae* sp.	*1	0.0370644	17.85	0.6616011	1
2	*Nymphaeae* sp.	2.71875	0.0074128	9.716	0.3601186	0.8
3	*Scripus* sp.	0.2	0.0259451	2.1335	0.079077	0.6
4	*Salvinia* sp.	3.44375	0.100769	1.44125	0.0534191	0.4
5	*Merrimia* sp.	0.7	0.0940511	12.1675	0.4509822	0.2
6	*Eichhornia* sp.	2.5375	0.1276408	3.32325	0.1231745	0.1
7	*Oriza* sp.	16.38	0.6071163	3.276	0.1214232	0.0
Total		26.98	0.9999995	49.9075	1.8497957 1.85	

Table 3: Relationship between Edge index (DI) of vegetation and open water showing SIV_2

Zone	Area (A) sq ft	Length of edge (L) ft	Edge index $Di = \frac{L}{2\sqrt{A\pi}}$	SIV_2
A	475084.97	878.2	0.3594205	1.0
P	63297.37	278.46	0.007001	0.7
C	253614.38	6.5	0.3388937	0.5
F	29586.6	384.0	0.490	0.3
E	18732.45	298.49	0.25002763	0.0

Table 4: Relationship between water regime and SIV_3

Zone	Flooding Type	Characteristic of Flooding	SIV_3
A	Perennially flooded	The water level is high during summer but in winter season the water concentrates in specific lower regions of the Zone with rich hydrophytes.	1.0
P	Permanently flooded	The water covers the land surface throughout the year. Vegetation is composed of obligate hydrophytes.	0.75
C	Semipermanently flooded	Surface water persists throughout the growing season of the year water level becomes very low with less hydrophytes.	0.5
F	Temporarily flooded	Surface water presents in brief period during the growing season but dries up during winter season.	0.25
E	Intermittently flooded	Surface water is present throughout the year except in year of extreme drought.	0.0

Table 5 : Evaluation of HSI values in studied zones

Zone	A	P	C	F	E
HSI	0.63	0.39	0.22	0.09	0.00

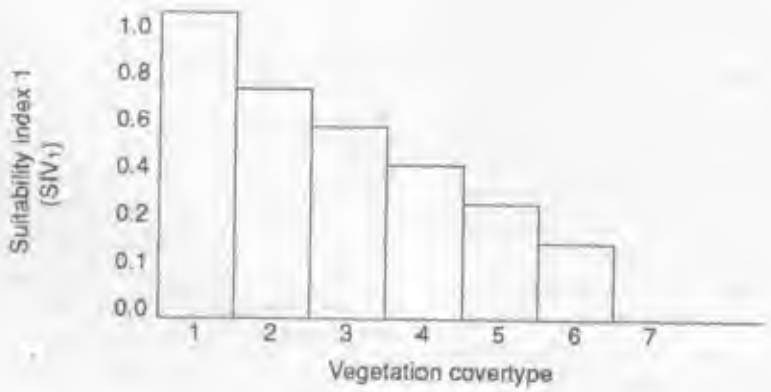

Fig.1. Graphical representation between SIV_1 and vegetation cover type.

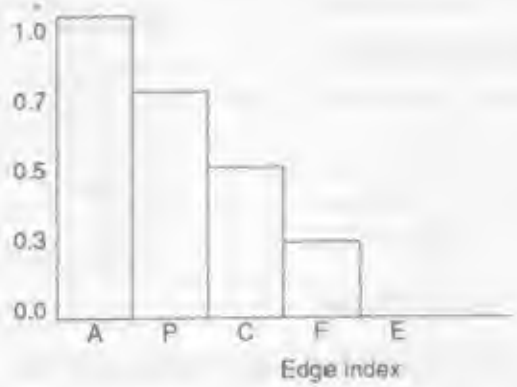

Fig. 2. Comparative account of relationship between SIV_2 and edge index in different zones.

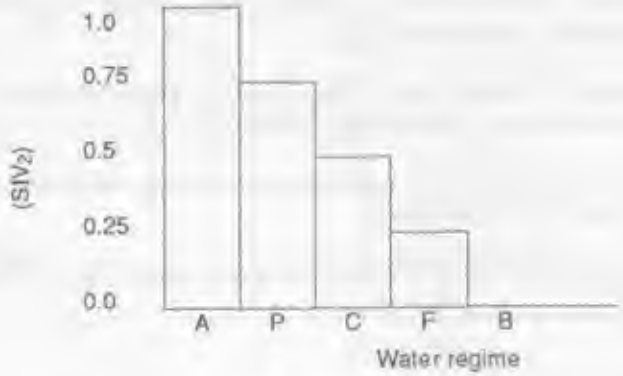

Fig.3. Relationship between SIV_3 and water regime in different zones.

Diversity of Bird Species in the Eastern Ghats of India

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Introduction

One of the relatively undisputed generalization in community ecology is an increase of species diversity from temperate to tropical region. Tropical rain forests have attracted many biologists to find out the factors of diversity and which determine them. Avifaunal group as attracted much more attention than any other communities. Diversity is the heterogenity created by the interaction of various factors in the habitat (Gadgil, 1986). It determines the nature of the habitat, and the study of these factors may provide the gradient distribution of the biota in the habitats.

Much work related to the avifaunal diversity has been done in temperate forests (Mac Arthur and Mac Arthur, 1961; Karr, 1968; Robinson and Holmes, 1984; Niem and Handwski, 1984). But a very limited data is available in the tropics (Karr and Roth, 1971, 1982; Terborgh and Wesek, 1969; Pearson, 1975; Love Joy, 1975; Beehler, 1978; Ripley, 1978; Price, 1979 and Johns, 1983). The Western and Eastern Ghats of India harboring a fairly rich faunal and floral wealth are relatively unexplored. Only a few reports are available pertaining to the Western Ghats, Daniels 1989 and Daniels *et al.*, 1990, 1991, 1992). Whistler and Kinnear (1932–1939) were the pioneers to study the whole Eastern Ghats. Other reports (Raju and Selvin, 1971; Raju and Price, 1973; Ali and Ripley, 1985; Bushan, 1986 and Bechler *et al.*, 1987) are limited to the Andhra Pradesh region and no studies are made in the Tamil Nadu region.

The present work was undertaken to study the diversity of birds and plants, species composition, and the impact of man made alteration in the Eastern Ghats of Tamil Nadu and Andhra Pradesh region.

Material and Methods

The Eastern Ghat extends over an area 1,42,072.89 km in the states of Orissa, Andhra Pradesh and Tamil Nadu and occupies 6.77% of the total geographic area of the Indian Republic. The length of the Eastern Ghat is about 1350 km and the width is about 140 km. The Eastern Ghat shows NE — SW stretching between north latitudes 11° 35' 85° 15'. The present work was carried out from April to July 1989 in selected forests of Tamil Nadu and Andhra Pradesh in the Eastern Ghats (Fig.1) Table 1 describes the locality, major vegetation type, month of sampling and transects laid in the respective habitats.

To estimate the bird species population 600 x 100 metre transect was laid on each habitat. Each sampling was done for three consecutive days between 06.00 to 0.800 hrs, and at each observation point two minutes were spent to enumerate the species. Random sampling was adopted for the plant species. Quadrat of 10 × 10 m were laid on alternative sides of each habitat and the plant species were recorded.

Shanon — Weiner index (1949) was adopted for calculating plant and bird species diversities.

$$H = \Sigma pi \times \log pi$$

where π is the proportion of the ith species in the sample.

To find out the similarity in bird species composition and abundance between the habitat types, the Jaccards (1908) similarity index was applied.

$$J = \frac{NC}{N_1 + N_2 - NC}$$

NC = Number of species in common
N_1 = Number of species in the first habitat
N_2 = Number of species in the second habitat

Correlation between plant and bird species diversity was calculated by using the formula of Karl Pearson's Coefficient of correlation r.

Results and Discussion

Species Number

A total number of 94 species was observed in the 9 transects and 145 species were recorded for the checklist. The joint survey by the Andhra Pradesh Natural History Society and the Smithsonian Institution, Washington D.C., recorded 160 species from the same area (Ripley *et al* 1987). The Verney expedition (1932-1939) recorded 172 species from the same area. The lesser number of bird species recorded in the present study might be due to the restricted area surveyed within a short period, climatic variations and/or the poor habitat structure. The dry deciduous forest with ecucalyptus plantation (T 2) had the maximum number of 38 bird species. Rezakhan (1972) concluded that eucalyptus plantations provided good undergrowth and food resulting in the abundants of insectivorous birds. Further, the eucalyptus plantation provide a good source of nectar, attracting a variety of forest birds such as Racket-tailed, Bronzed and Haircrested Drongos, Lorikeets and Hill Mynas, (Daniels *et al* 1990). Nectar is the source of sugar for a lot of insectivorous birds (Ali and Ripley, 1983).

A dry deciduous natural forest (T6) had 36 species of birds next to T2. The natural forest with high density of trees with enough canopy provides a good habitat for a variety of birds (James and Warmer, 1982). The moist deciduous forest above 2000 m MSL had the minimum number of 13 species of birds. The reason might be due to the higher altitude.

The dry deciduous forest with eucalyptus plantations (T2) and the scrub jungle with eucalyptus plantation had higher species richness and the moist deciduous forest above 2000 m MSL had a low species richness. Connell (1978) pointed out that man altered forests had higher species richness and Kikkawa and Williams (1971) reported that higher altitude reduces the species richness.

Species diversity

A higher Shannon - Weiner index was obtained in dry decidious forest (T6) (Table 2). Similar observations were made by James and Warner (1982). The moist deciduous forest T5 above 2000 m MSL had lesser bird species diversity. Kikkawa and Williams (1971) reported that the bird species diversity decreases with the increase in altitude. Welty (1982) concluded that the decrease of temperature with the increase in altitude may reduce the bird species diversity.

Scrub jungle with eucalyptus plantation (T8) had higher plant species diversity and moist deciduous forest (T4) had a lower diversity. Connell (1978) relates high levels of plant diversity to disturbed conditions and lower to stable tropical forests.

Similarity in bird species composition between vegetation types studies

The maximum similarity index of birds was observed between the scrub jungle with eucalyptus plantation (T8) and the dry deciduous with eucalyptus plantation T2 (Tables and 3 and 4). Dissimilarities were observed between moist deciduous (T4) and teak plantation (T9). The maximum similarity of plant species was observed between dry decidious (T1) and dry deciduous with eucalyptus plantation (T2).

Correlation between bird and plant species diversity

A high positive correlation between plant and bird species diversity (+0.81) was obtained and linear regression (y=a+bx; a = 0.801, b = 0.6628) was calculated (Fig.2). Karr (1976) reported that the bird species diversity correlated to the availability and exploitation of food substances and other resources in the habitats. Structural characteristics of vegetation are directly correlated to bird diversity (Anderson and Ohmart, 1977) The increase in the height of foliage has a positive correlation (MacArthur and MacArthur, 1961 and 1964, Mac Arthur *et al*, 1966, and Karr,1968).

Vertical stratification

The major proportion of birds were found in the canopy and remarkably very low proportion of birds were found at the ground level. The foliage profile, weather, and the availability of fruits, insects and nectar may possibly cause the vertical stratification (Bell, 1970).

Food Preferences of the birds

Percentage of different food habits of birds from different habitats is given in Table 5. Insectivores were dominant in the dry deciduous with eucalyptus plantation and teak plantation. Omnivores dominated in the dry deciduous and moist deciduous forest above 2000 m MSL. Frugivores were dominant only in the moist deciduous. Nectar is the only source of to a sugar to variety of insectivorous birds. The eucalyptus plantation provides a good source of nectar (Daniels, 1989)and may be the reason for more insectivorous birds in forests having eucalyptus plantation. Further, according to Rezhakhan (1972) these plantations support a good under cover storey growth leading to the abundance of insects.

From the present work and earlier reports, it is inferred that the tropical rain forests of the Eastern Ghats with their wealth of specialist and endemic species and sub species of birds are slowly giving way to a more genalised and widespread plantation as a result of human interference. In the present work the habitats with eucalyptus plantation had higher number of species, species richness, and diversity of species than natural forests. The plantation support good undergrowth resulting in abundant food for many insectivores. Nectar is another factor attracting a variety of birds. The plantation support good undergrowth resulting in abundant food for many insectivores.

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Table 1 : The different vegetation types studied and their location

Transect No.	Locality	Major vegetation types	Month of sampling
1.	Shevaroy hills , Salem Dt.	Dry deciduous	April 1989
2.	Shevaroy hills , Salem Dt.	Dry deciduous with Eucalyptus plantation.	April 1989
3.	Chitteri hills, Dharmapuri Dt.	Dry deciduous	May 1989
4.	Coonoor hills	Moist deciduous	May 1989
5.	Coonoor hills	Moist deciduous (2000M.S.L.)	May 1989
6.	Kurumbapatty RF, Salem Dt.	Dry deciduous	June 1989
7.	Thatipudi (A.P)	Scrubjungle	July 1989
8.	Thatipudi	Scrubjungle with Eucalyptus	July 1989
9.	Thatipudi	Teak plantation	July 1989

Table 2 : The number and individual plant & bird species and their diversity in different localities

Transect No.	Number of bird species	No. of individuals	No. of plant species	No. of individuals	Shanon-Weiner birds	Diversity index plants
1.	31	219	13	167	2.2869	2.1116
2.	38	377	11	181	2.6002	2.0169
3.	25	144	9	117	2.2816	1.8178
4.	21	150	5	102	2.2114	1.3194
5.	13	118	5	111	1.9044	1.4014
6.	36	334	8	108	2.7627	1.6571
7.	34	322	11	136	2.6706	1.9167
8.	35	267	13	243	2.6817	2.1378
9.	24	109	10	136	2.3896	1.7438

Table 3 : Transect wise similarity index for bird species on the nine transects of the study areas of the Eastern Ghat of Tamil Nadu & Andhra Pradesh during the study period, April to July 1989

	Transects								
	1	2	3	4	5	6	7	8	9
1	–								
2	0.43	–							
3	0.24	0.21	–						
4	0.08	0.04	0.15	–					
5	0.1	0.04	0.19	0.13	–				
6	0.03	0.32	0.17	0.04	0.09	–			
7	0.03	0.36	0.20	0.04	0.09	0.35	–		
8	0.43	0.49	0.22	0.06	0.06	0.27	0.35	–	
9	0.25	0.29	0.19	0.02	0.06	0.22	0.09	0.37	–

Table 4: Transect wise similarity index for plant species on the nine transects of the study areas of the Eastern Ghat of Tamil Nadu & Andhra Pradesh during the study period, April to July 1989

	Transects								
	1	2	3	4	5	6	7	8	9
1	–								
2	0.21	–							
3	0.10	0.05	–						
4	0.05	0.00	0.07	–					
5	0.00	0.00	0.00	0.00	–				
6	0.15	0.18	0.11	0.07	0.00	–			
7	0.00	0.05	0.00	0.00	0.00	0.00	–		
8	0.04	0.15	0.04	0.00	0.00	0.15	0.20	–	
9	0.045	0.11	0.00	0.00	0.00	0.11	0.16	0.15	–

Table : 5 : Percentages of the various feeding types of bird species that were present in the study area during the study period April to July 1989

Transect Number	Omnivores	Carnivores	Frugivores	Insectivores	Nectarivores	Gramnivores
1	44.44	0.44	0.88	38.22	4.00	12.00
2	36.64	2.19	14.03	40.13	3.07	05.92
3	36.11	1.39	23.61	36.02	1.38	03.47
4	30.06	1.96	32.02	26.79	4.58	04.58
5	43.22	0.85	09.32	40.68	4.24	01.69
6	49.86	0.26	05.12	26.95	1.62	16.17
7	26.58	0.33	15.95	44.85	0.99	11.30
8	30.03	0.61	15.02	43.13	3.51	07.61
9	23.30	3.01	19.55	39.10	3.00	12.03

Fig. 1

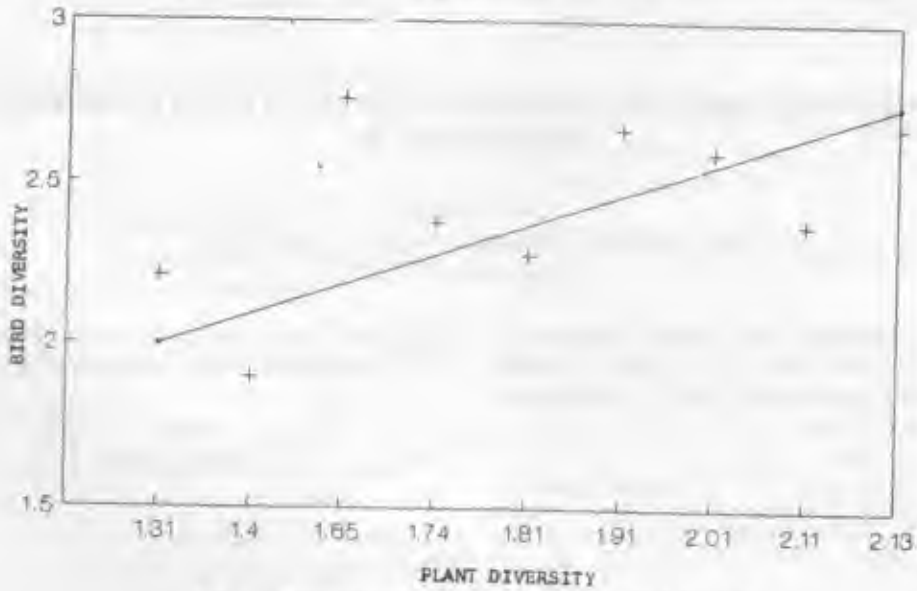

Fig.2. Regression on plant diversity vs. bird diversity

A Preliminary Survey of Egrets and Pond Herons in the Water Resources of Sivakasi, Tamil Nadu

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Introduction

The birds, *Ardeola greyii* (Pond heron), *Ardea alba* (Large egret) and *Bubulcus ibis* (Cattle egret) have been incriminated both in maintenance and dissemination of Japanese Encephalitis (JE) virus, that causes brain fever in man. Earlier investigation (ICMR, 1980) showed that pond herons and cattle egrets develop viraemia in sufficiently high titres to infect mosquitoes which feed on them and such transmit the JE virus. Similar studies are meagre, especially in Tamil Nadu. Therefore, a preliminary survey of egrets was made in the reservoirs of Sivakasi, Tamil Nadu.

Material and Methods

The survey was made once a month (February–October 1993) in selected places in the small industrial town, Sivakasi (Lat 9° 27' N; Long 77° 498' E), Tamil Nadu, India. The pictorial guide of Ali and Ripley (1983) was used in the identification of egrets.

Results and Discussion

The survey revealed that the number of egrets observed in the ponds was more when compared with the sewage canal (Table 1). Eighteen *Ardea alba* was observed in the Satchiyarpuram pond whereas 3 to 5 egrets were counted in the sewage canal in September 1993. This may be probably due to the presence of food substances, such as, frogs, tadpoles, fingerlings and aquatic insects in the pond.

The availability of the cattle egret populations is dependent on the vegetation in the field More cattle egrets (120) were observed during the month of February '93 and gradually decreased to two egrets in the month of July '93. A couple of the pond heron, *Ardeola greyii* was observed during the survey period which may be probably due to seasonal occurrence of this bird.

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A Preliminary Field Report on 1993 Winter Survey of Birds in the Nehru Park, Allahabad (U. P)

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The Nehru Park, Allahabad is a suitable abode for a number of avian species both aquatic and terrestrial. The present account is only an initial report of the avifauna of the Park surveyed during Feb/March 1993. The Park including the Mcfersion lake covering an area of about 160 acres attracts 124 species of birds. Of these 18 species were identified as migrants, 21 resident migrants and the remaining 85 species as residents. The record of the number of avian species observed in different habitat types during the present investigation are given below :

Lake	35
Red beds	11
Medium and tall trees	39
Bushes	32
Grass beds	17

Some Observations on the Birds of Silent Valley National Park

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Introduction

Conservation of biological diversity is of prime importance in the overall conservation strategy of an area. Silent Valley Forests after being declared a National Park is being given maximum attention to preserve the existing diversity. This short study was meant to ascertain the status of the bird population of the National Park. Here measures such as protection against wildfire and reduction of anthropogenic interferences to a minimum are slowly beginning to pay back. Increasing sightings of habitat specialists and endemic bird species (as per the list prepared by the ICBP Biodiversity Project in the Oriental Region) and the even and uniform distribution of the avifauna may be considered as good indications of the departure from the estrangements of habitat fragmentations.

It has been reported in the earlier studies that the number of birds occurring in the National Park is 100+ (Unnikrishnan, 1990–Management Plan). Jayson (1990) reported 119 species. The present study updated the list to 192 (including 156 from the core area and 36 from the buffer zone).

Material and Methods

Silent Valley National Park, situated in Palakkad District of Kerala is a plateau lying at an elevation ranging from 658 to 2383 m above MSL (Latitude 11.4' and 11.13'N and Longitude 76.24' and 76.29'E). Along northern boundary lies the forests of Nilambur South division and Nilgiris. Southern boundary is formed by forests of Palakkad division and to the east Attappady Reserved Forests. Forests of Nilambur forms the west boundary.

The total area of the National Park is 8952 hectares of which 1/5th is grassland.

The major forest types are :

a) West coast tropical evergreen forests
b) Southern subtropical hill forests
c) Southern montane wet temparate forests and
d) Southern montane wet grasslands,

apart from rocky areas and narrow strips of degraded forests.

The plateau slopes towards the bed of river Kunthipuzha which runs through the Park in a north-south direction.

Well-marked variation in the intensity of rainfall has been observed across this area. Sairandry (elevation 990 m.) receives 3180 mm. Nilikkal (elevation 1000 m.) gets about m. western slopes receive 4550 mm. and northern most portion receives the highest rainfall, i.e. 7500 mm. Average minimum temperature ranges from 8–14°C and average maximum temperature varies from 23–29°C.

A pilot survey was conducted during December 1990 which was attended by many amateur and professional birdwatchers from the region. The participants were stationed at four different locations inside the Park and observations on birds were made along many 1 km transects simultaneously for four days. Details of birds sighted and the frequency of sightings for each bird are given in the Appendix.

The present study was undertaken from March to May 1991. Fourteen 1 km. transects were identified inside the National Park covering all types of habitats. The bird species diversity obtained is made comparable with the analysis of bird species diversity versus structural composition of the vegetation data of Daniels, 1990. Habitat preferences of rare birds and all the available breeding data were also recorded.

Results and Discussion

Number of species observed in each transect and addition of new species during the subsequent visits remained more or less constant all through the study period indicating a somewhat uniform distribution of the avifauna throughout the core area of the Silent Valley National park. A total of 156 birds (including 30 winter visitors – see Appendix) were observed in core area and 36 (including 2 winter visitors) were seen in the buffer zone (which were not sighted within the core area) where the habitat distinction is relatively well-marked. Altogether the total number of species sighted was 192 when compared to the data from earlier studies including 32 winter visitors.

The breedings of some of the resident birds were observed during the study period.. Out of this, the breedings of Malay Bittern and Shaheen Falcon have not so far been reported from Kerala.

Altogether seven species of birds were sighted which have not been included in Birds of Kerala. The details are shown in the Appendix.

Systematic long term monitoring is highly essential for understanding the seasonal variations, territoriality and relative abundance of the bird community in Silent Valley National Park.

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Appendix

List of Birds sighted at Silent Valley during the Pilot Survey in December 1990

1. Pond Heron
2. Black Bittern
3. Black winged Kite
4. Crested Honey Buzzard
5. Crested Goshawk
6. Asiatic Sparrow Hawk
7. Besra Sparrow Hawk
8. Cresed Hawk Eagle
9. Bonelli's Hawk Eagle
10. Rufousbellied Hawk Eagle
11. Black Eagle
12. Greyheaded Fishing Eagle
13. Montagu's HJarrier
14. Shorttoed Eagle
15. Crested Serpend Eagle
16. Shaheen Falcon
17. Kestrel
18. Painted Bush Quail
19. Red Spurfowl
20. Grey Junglefowl
21. Common Bustard Quail
22. Southern Green Pigeon
23. Greyfronted Green Pigeon
24. Jerdon's Imperial Pigeon
25. Nilgiri Wood Pigeon
26. Emerald Dove
27. Blossomheaded Parakeet
28. Bluewinged Parakeet
29. Malabar Lorikeet
30. Redwinged Crested Cuckoo
31. Drongo Cuckoo
32. Crow Pheasant/Coucal
33. Brown Hawk Eagle
34. Greateared Nightjar
35. Longtailed Nightjar
36. Jungle Nightjar
37. Ediblenest Swiftlet
38. Brownthroated Spinetail Swift
39. Whiterumped Spinetail Swift
40. Alpine Swift
41. Malabar Trigon
42. Small Blue Kingfisher
43. Three toed Forest Kingfisher
44. Whitebreasted Kingfisher
45. Brownheaded Storkbilled Kingfisher
46. Chestnutheaded Bee eater
47. Malabar Grey Hornbill
48. Small Green Barbet
49. Crimsonthroated Barbet
50. Speckled Piculet
51. Goldenbacked 3 toed Woodpecker
52. Great Black Woodpecker
53. Pigmy Woodpecker
54. Heart Spotted Woodpecker
55. Larger Goldenbacked Woodpecker
56. Indian Pitta
57. Nilgiri House Swallow
58. Redrumped Swallow
59. Wiretailed Swallor
60. House Martin
61. Cliff Swallow
62. Crag Martin
63. Dusky Crag Martin
64. Brown Shrike
65. Golden Oriole
66. Blacknaped Oriole
67. Grey Drongo
68. Bronzed Drongo
69. Racket-tailed Drongo
70. Hill Myna
71. Southern Tree pie
72. Pied Flycatcher Shrike
73. Malabar Wood Shrike

74. Large Cuckoo Shrike
75. Blackheaded Cuckoo Shrike
76. Orange Minivet
77. Goldfronted Chloropsis
78. Fairy Blue Bird
79. Greyheaded Bulbul
80. Rubythroated Bulbul
81. Red whskered Bulbul
82. Red vented Bulbul
83. Yellow browed Bulbul
84. Black Bulbuul
85. Spotted Babbler
86. Scimitar Babbler
87. Blackheaded Babbler
88. Rufous Babbler
89. Wynaad Laughing Thrush
90. Quaker Babbler
91. Brown Flycatcher
92. Brownbreasted Flycatcher
93. Rufoustailed Flycatcher
94. Black and Orange Flycatcher
95. Whitebellied Blue Flycatcher
96. Tickell's Blue Flycatcher
97. Verditer Flycatcher
98. Nilgiri Verditer Flycatcher
99. Greyheaded Flycatcher
100. Paradise Flycatcher
101. Blacknaped Blue Flycatcher
102. Franklin's Wren Warbler
103. Broadtailed Grass Warbler
104. Blyth's Reed Warbler
105. Tickell's Leaf Warbler
106. Largecrowned Leaf Warbler
107. Greenish Leaf Warbler
108. Rufousbellied Shortwing
109. Blue Chat
110. Blackheaded Rock Thrush
111. Malabar Whistling Thrush
112. Whitethroated Ground Thrush
113. Nilgiri Thrush
114. Black Bird
115. Yellow cheeked Tit
116. Velvet fronted Nuthatch
117. Nilgiri Pipit
118. Forest Watgail
119. Grey Wagtail
120. Grey Wagtail
121. Nilgiri Flowerpecker
122. Purple rumped Sunbird
123. Small Sunbird
124. Maroon breasted Sunbird
125. Little Spiderhunter
126. White Eye
127. White backed Munia
128. Bufousbellied Munia
129. Rosefinch

Birds seen in the buffer zone (but not inside the core area during the pilot survey in December 1990

1. Ceylon Shikra
2. Spotted Dove
3. Roseringed Parakeet
4. Barred Jungle Owlet
5. Bluetailed Bee-eater
6. Malabar Pied Hornbill
7. Malabar Goldenbacked Woodpecker
8. Crimsonbreasted Barbet
9. Blackheaded Oriole
10. Common Myna
11. Jungle Myna
12. Common Tree Pie
13. Common Wood Shrike
14. Ceylon Iora
15. Jerdon's Chloropsis
16. Jungle Bubbler
17. Ashy Wren-Warbler
18. Plain Wren-Warbler
19. Tailor Bird
20. Magpie Robin
21. Grey Tit
22. Large Pied Wagtail
23. Purple Sunbird

Total : 129 + 23 = 152 species

Frequency of Sightings of Birds in Silent Valley during the Pilot Survey – December 1990

Sl. No.	Species	Frequency of sightings
1	Small Sunbird	415
2	Black Bulbul	405
3	Yellowbrowed Bulbul	253
4	Malabar Whistling Thrush	204
5	Small Green Barbet	194
6	Greenish Leaf Warbler	145
7	Blyth's Reed Warbler	132
8	Quaker Babbler	120
9	Scimitar Babbler	119
10	Ashy Drongo	115
11	Largecrowned Leaf Warbler	98
12	White eye	96
13	Jerdon's Imperial Pigeon	83
14	Redwhiskered Bulbul	70
15	Paradise Flycatcher	59
16	Emerald Dove	57
17	Greyheaded Flycatcher	54
18	Nilgiri Verditer Flycatcher	47
19	Malabar Lorkeet	43
20	Chestnutheaded Bee-eater	39
21	Tickell's Leaf Warbler	35
22	Nilgiri Flowerpecker	35
23	Whitethroated Ground thrush	33
24	Goldenbacked 3-toed Woodpecker	29
25	Grey Wagtail	29
26	Black Bird	27

Sl. No.	Species	Frequency of sightings
27	Malabar Grey Hornbill	27
28	Blackwinged Kite	24
29	Rufoustailed Flycatcher	25
30	Little Spiderhunter	21
32	Velvetfronted Nuthatch	21
32	Racket-tailed Drongo	20
33	Black Eagle	20
34	Golden Oriole	20
35	Brown Flycatcher	18
36	Blueheaded Rock thrush	18
37	Hill Myna	18
38	Whitebellied Blue Flycatcher	18
39	Blue Cat	17
40	Blackheaded Babbler	16
41	Yellowcheeked Tit	16
42	Bluewinged Parakeet	15
43	Orange Minivet	14
44	Grey Junglefowl	14
45	Whiterumped Spinetail Swift	14
46	Blossomheaded Parakeet	13
47	Malabar Wood Shrike	12
48	Edible Nest Swiftlet	12
49	Verditer Flycatcher	12
50	Franklin's Wren Warbler	11
51	Whitebellied Tree Pie	11
52	Crested Serpent Eagle	10
53	Great Black Woodpecker	9
54	Redrumped Swallor	8
55	Fairy Blue Bird	9
56	Greyfronted Green Pigeon	7
57	Black naped Blue Flycatcher	7
58	Brown Shrike	7
59	Malabar Progon	7
60	Bronzed Drongo	7
61	Forest Wagtail	7
62	Purplerumped Sunbird	6
63	Shaheen Falcon	6
64	Asiatic Sparrow Hawk	5
65	Cliff Swallow	5
66	Spotted Battler	5
67	Heartspotted Woodpecker	5
67	Wynad Laughing Thrush	5
69	Crested Hawk Eagle	4
70	Alpine Swift	4
71	Brownbreasted Flycatcher	4
72	Thickbilled Flowerpecker	4

Sl. No.	Species	Frequency of sightings
73	Nilgiri Wood Pigeon	3
74	Blackheaded Cuckoo Shrike	3
75	Indian Pitta	3
76	Painted Bush Quail	3
77	Kestrel	3
78	House Martin	3
79	Rufousbellied Munia	3
80	Gold fronted Chloropsis	3
81	Greyheaded Bulbul	2
82	Speckled Piculet	2
83	Besra Sparrow Hawk	2
84	Rufousbellied Shortwing	2
85	Short-toed Eagle	2
86	Nilgiri Thrush	2
87	Crag Martin	2
88	Red vented Bulbul	1
89	Small Green Bee eater	1
90	Pied Flycatcher Shrike	1
91	Larger Goldenbacked Woodpecker	1
92	Rosefinch	1
93	Bonelli's Hawk Eagle	1
94	Storkbilled Kingfisher	1
95	House Swallow	1
96	Dusky Crag Martin	1
97	Malay Pipit	1
98	Jungle Nightjar	1
99	Large Cuckoo Shrike	1
100	Greyheaded Fishing Eagl e	1
101	Rufous Babbler	1
102	Greateared Nightjar	1
103	Red Spurfowl	1
104	Maroonbreaste d Sunbird	1
105	Tickell's Blue Fl ycatcher	1
106	Whitebreasted Kingfisher	1
107	Crested Honey Buzzard	1
108	Rufousbellied Hawk Eagle	1
109	Southern Green Pigeon	1
110	Common Bustard Quail	1
111	Red winged Crested Cuckoo	1
112	Crow pheasant/Coucal	1
113	Brown Hawk Owl	1
114	Small Blue Kingfisher	1
115	Threetoed Forest Kingfisher	1
116	Pigmy Woodpecker	1
117	Wiretailed Swallow	1
118	Rubythroated Bulbul	1
119	Black Bittern	1
120	Pond Heron	1

Birds Sighted at Mukali
(not sighted inside the core area)

Family : Ardeidae			
1	38	Little Green Bittern	*Butorides striatus*
2	49	Little Egret	*Egretta garzeta*
Family : Accipitridae			
3	135	Brahminy Kite	*Haliastur indus*
4	139	Ceylon Shikra	*Accipiter badius*
Family : Rallidae			
5	344	White breasted waterhen	*Amaurornis phoenicurus*
Family : Columbidae			
6	537	Spotted Dove	*Streptopelia chinensis*
Family : Psittacidae			
7	550	Rose ringed Parakeet	*Psittacula krameri*
Family : Cuculidae			
8	573	Common Hawk Cuckoo	*Cuculus varius*
9	576	Indian Cuckoo	*Cuculus micropterus*
10	582	Bay banded Cuckoo	*Cacomantis sonneratii*
11	584	Plaintive Cuckoo	*Cacomantis merulinus*
Family : Strigidae			
12	623	Collared Scops Owl	*Otus bakkamoena*
13	636	Barred Jungle Owlet	*Glaucidium radiatum*
Family : Meropidae			
14	748	Blue tailed Beeeater	*Merops philippinue*
Family : Buceroptidae			
15	775	Malabar Pied Hornbill	*Anthracoceros coronatus*
Family : Capitonidae			
16	792	Crimsonbreasted Barbet	*Megalaima hemacephala*
Family : Picidae			
17	816	Small Yellownaped Woodpecker	*Picus chlorophus*
18	820	Lesser Golden-backed Woodpeckerj	*Dinopium benghalense*
Family : Oriolidae			
19	959	Black headed Oriole	*Oriolus zanthornus*
Family : Dicruridae			
20	963	Black Drongo	*Dicrurus adsimilis*
Family : Artanidae			
21	982	Ashy Swallow Shrike	*Artaus fuscus*
Family : Sturnidae			
22	1006	Common Myna	*Acridotheres tristis*
23	1010	Jungle Myna	*Acridotheres fuscus*
Family : Corvidae			
24	1033	Tree Pie	*Dendrocitta vagabunda*
Family : Campephagidae			
25	1070	Common Wood Shrike	*Tephrodornis pondicerianus*
Family: Irenidae			
26	1101	Common Iora	
27	1107	Jerdon's Chloropsis	*Chloropsis cochinchinensis*
Family : Muscicapidae **Sub family : Timaliinae**			
28	1264	Jungle Babbler	*Turdoides striatus*
Family : Muscicapidae **Sub family : Sylvilnae**			
29	1511	Plain Wren - Warbler	*Prinia subflava*
30	1535	Tailor Bird	*Orthotomos sutorius*
Family : Muscicapidae **Sub family : Turnidae**			
32	1661	Magpie Robin	*Copsychus saularis*
Family : Paridae			
33	1795	Grey Tit	*Parus major*
Family : Motacillidae			
34	1891	Large Pied Wagtail	*Motacilla maderaspatensis*
Family : Nectariniidae			
35	1917	Indian Purple Sunbird	*Nectarinia asiatica*
Family : Plocidae			
36	1968	White backed Munia	*Lonchura striata*

List of Winter Visitors of Birds
In Silent Valley National Park

1. Asiatic Sparrow Hawk
2. Booted Hawk Eagle

3 Montagu's Harrier
4 Redwinged Crested Cuckoo
5 Short eared Owl
6 Indian Pitia
7 Crag Martin
8 House Martin
9 Brown Shrike
10 Golden Oriole
11 Black naped Oriole
12 Grey Drongo
13 Brown Flycatcher?
15 Rufous tailed Flycatcher
16 Red breasted Flycatcher
17 Blue throated Flycatcher
18 Verditer Flycatcher
19 Paradise Flycatcher
20 Thickbilled Warbler
21 Blyth's Reed Warbler
22 Tickell's Leaf Warbler
23 Greenish Leaf Warbler
24 Large Crowned Leaf Warbler
25 Blue Chat
26 Blue headed Rock thrush
27 Black capped Black Bird
28 Forest wagtail
29 Indian Tree Pipit
30 Rosefinch

Migrants in the buffer zone

1 Indian Cuckoo
2 Blue tailed Bee eater

APPENDIX

General Composition of the mixed hunting flocks of birds observed at Silent Valley during the present study — December 1990, March–May 1991

An analysis for the species composition of mixed hunting flocks of birds encountered during the field trips in Silent Valley gives the following combination of species as the most common one

1 Black Bulbul
2 Small Sunbird
3 Orange Minivet
4 Large Crowned Leaf Wabler
5 Velvet fronted Nuthatch
6 Yellow Cheeked Tit
7 Grey headed Flycatcher
8 Quaker Babbler
9 Scimitar Babbler
10 Black headed Babbler
11 Spotted Babbler
12 Racket Tailed Drongo
13 White bellied Blue Flycatcher
14 Black naped Blue Flycatcher
15 Speckled Piculet
16 Goldenbacked three toed Woodpecker
17 Yellow Browed Bulbul
18 Fairy Blue Bird

List of birds sighted at silent valley that are not included in "Birds of Kerala"

No.	Species	Date of sighting	Place of sighting
1.	Nilgiri Laughing Thrust (Garrulax cachinnans)	4-4-1991	Sispara
2.	Roufous bellied Shortwing (Brachypteryx major major)	27-12-1990	Nilikkal
3.	House Martin (Delichon urbica)	28-12-1990	Nilikkal & Poochipara
4.	Cliff swallow (Hirundo fluvicola)	28-12-1990 & 4-4-1991	Walakkad & Sispara
5.	Crag Martin (Hirundo rapestris)	28-12-1990	Sairandri
6.	Peninsular Scops Owl (Otus scops rufipennis)	8-5-1991	Sairadri
7.	Wiretailed swallo (Hirundo smithii)	28-12-1990	Walakkad

Impact of Stone Crushing Units on the Populations of Redvented Bulbul, *Pyctonotus cafer*

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The shrub jungles situated around Bhavanisagar harbour a large number of trees like *Acacia nilotica, A.leucophloea, A.planifrons, Commiphora berryi, Zizyphus* sp., *Carissa* sp., *Tamarindus indica, Azadirachta indica* and *Ficus* spp. Dense growth of *Lantana* and other shrubs and several berry bearing climbers also form part of the flora here. This forest area is a favoured habitat for Redvented Bulbul, *Pycnonotus cafer*. The bulbuls feed on many kinds of berries available here and a rich insect fauna also support these birds. The breeding season for the Bulbuls is from March to June which sometimes extend up to July.

Since 1991, two Stone Crushing Units have been functioning well within the vicinity of this forest. These units are engaged in manufacturing various sizes of 'blue metal' for manufacturing cement concrete. These units while breaking, crushing and polishing blue metals emit large quantities of very fine granite powder in the air.

This powder is carried along the windward direction and deposited on the trees and shrubs. The trees get affected. The suitability of such polluted habitat to Redvented Bulbuls was studied.

Counts of bulbuls with a pair of 7 x 50 binoculars was made 24 times during morning (0600 to 0800 hr) and evening (1630 to 1830 hr). Eggs were identified following Satyamurti (1979).

The data indicate the presence of an endemic resident population of *P.cafer* with a limited local movement during March to June. This could be attributed to availability of fruits in the nearby Mango and other orchards.

The population increases during rainy season commencing from October to December. The Redvented Bulbul has been observed as a pest of Cashew apples, mango and other fruits in the orchards of nearby Agricultural Research Station, Bhavanisagar.

The low level sighting of *P.cafer* in the areas affected by the granite dust indicates the deleterious effects of the dust on the bulbul.

There was a marked reduction (81.67%) in the population in the area of Stone Crushing Units. The nesting and breeding activity seems to be completely absent in the affected areas. During the 1992 and 1993 breeding seasons the pattern was the same with three nests built and only two eggs laid in one nest. These two eggs were also abandoned by the parents. This indicates that *P.cafer* no more breeds in the area affected by the fine granite dust blown from the stone crushing units.

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Table 1 : Sighting of Redvented Bulbul in stone crushing units of Bhavanisagar

Month	No. of Bulbuls in Affected area	unaffected area
July '91	26	107
August '91	17	101
September '91	23	126
October '91	29	114
November '91	32	149
December '91	45	208
January '92	30	173
February '92	12	106
March '92	18	92
April '92	23	80
May '92	32	103
June '92	26	96
July '92	31	129
August '92	39	117
September '92	26	140
October '92	31	164
November '92	44	197
December '92	38	235
January '93	27	156
February '93	21	119
March '93	27	89
April '93	19	63
May '93	20	82
Total	540	2946

Table 2 : Nesting and breeding of Redvented Bulbul (*Pycnonotus cafer* Linn.) in the vicinity of stone crushing units

Month	No. of of Bulbuls in Affected Area			Unaffected Area		
	Nests	Eggs	Fledglings	Nests	Eggs	Fledglings
March '92	–	–	–	9	23 –	
April '92	–	–	–	13	30	16
May '92	2	1	–	19	41	27
June '92	2	–	–	21	18	27
March '93	–	–	–	12	25	8
April '93	1	–	–	19	31	21
May '93	3	2	–	24	39	32
June '93	3	–	–	23	19	24

Observations and Recommendations Concerning Some Serious Ecological Problems of Wetland Bird Habitats in the Bangalore Region, Peninsular India

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Introduction

The term 'Wetland' is much familiar following awareness and also conservation efforts in real terms in light of the IUCN definition and that defined at the convention on wetlands at Ramsar (Iran) in 1971. Wetlands have come to be realized as extremely important and highly dynamic ecological pockets possessing tremendous biomass production potentials and capable of harbouring a rich and diverse faunal & floral populations. Wetland ecosystems and the wide variety of resources they treasure within and support outside them are of immense value to man. However, the last three decades have shown phenomenal landuse and landscape changes. Presence of forests also ensures a more efficient watershed mechanism for tanks. Forest area losses for other land use has been tremendous. About 5.17% of protected and reserved forest area prior to 1960 had been reduced to 1.5% in Bangalore District by 1988 (Ravindra 1992). Of an area of 652 sq.kms., considered for Satellite imagery studies by ISRO (report No.TR-55-1985) shows increase in built up area from 6.1% (in 1912) to 48.7% by 1985. Further, from 1961-83, land use for urban area had increased from 28000 to 50100 Ha; of this a mere 10% remains as parks, playgrounds and recreational area. Industrial and residential land use have shown most phenomenal changes, transport facilities on land being another significant area lately. Significantly therefore, there has been a tremendous shift from a rural user basis of wetlands to an urban oriented Bangalore.

Material and Methods

The observations are based on a survey of 97 tanks of Bangalore carried out as a part of the Asian Waterfowl census in 1989. A large variety of data about wetland status carried out forms the basis of the present study. Standard methods for various analysis like water, plankton, vegetation etc., have been detailed in the Survey report, 1990. The observations presently considered are based on information collected through a wetland questionnaire. Results concerning the threats have been to brought out pointiws. Some of the threats have been recorded on a presence/absence basis as quantification was beyond the scope of the preliminary survey.

Results and Discussions

The most noticeable (hence bio-indicative) and attractive faunal components wetlands can support and sustain if allowed to, are birds especially waterfowl. The expert committee for preservation of tanks in Bangalore in its report (1986) observes that with a rapid growth of Bangalore's population and proliferation of buildings, roads and vehicular traffic, water sheets and trees become valuable assets to improve the health and quality of life for Bangalore's residents. Bangalore district helped by its fairly hilly terrain and unique climatic features also possesses phenomenal freshwater wetland and aquatic resources. Many studies by others on limnology, productivity etc., have indicated efficient production patterns as is expected in the tropical waters extending between 10°N and 12°N latitudes (Brylinsky & Mann 1973).

Ecological threats could affect the wetlands at various levels. This would affect the waterfowl supported by the habitat.

Information collected revealed that historically and to some extent even today in suburban and rural part of the district the 'Rural user' concept comprised the following utilities. (Chakrapani 1990)

All tanks served irrigation needs as the first priority substantially provided for irrigation, even as late as 1989.

Provided extended supply of water for inhabitants for domestic, drinking and washing needs during non rainy days of the year, thus acting as water banks.

Recharged groundwater and other water sources like wells, nullahs, streams etc.,

Supported wetland ecological trophic chains with diverse flora & fauna like microorganisms, plankton, aquatic vegetation, insects and insect larvae, fish, amphibians and finally birds including waterfowl, both resident and of more ecological consequence, the migrant.

Served as refuges for wetland wildlife, both flora and fauna.

Shore and catchment areas, served as grazing land for villages merely.

Control of water regime and microclimate of the district in the form of open water sheet expanses and shore areas.

In present day sub-urban/urban conditions, the utilities mainly are :

Recreational areas, microclimate control pockets and refuges for wetland fauna, flora and waterfowl in less threatened tanks.

Water recharging resources and as as mini water treatment facilities in the absence of adequate waste water treatment plants.

Threats faced by wetlands

Wetlands of Bangalore especially over the last 3 decades have become rapidly vulnerable to accidental and intentional human interference than any other habitats. This is because the 3 vital characteristics of tanks viz., water levels, water quality and the shore status can be very easily and rapidly altered to spoil the life support system of wetlands. Excessive water inflow or outflow, eutrophication through sewage or leached down pollutants; agricultural or industrial, with or without synergistic effects and bad shore management would all impose very severe constraints on waterfowl. Unsuitability to is naturally followed by unsuitability to man in course of time.

Water Quality :

Water samples from 78 tanks were analysed. The rest were dry. The of analyses details are available in the survey report 1990. Bangalore district has mainly coarsely textured red sandy loam soil and hence provides for good drainage. This is good from wetland management points of view and for recharging abilities and maintainance of water tables.

Production here essentially refers to the capacity of tank waters, to generate and sustain a wide diversity & ideal population sizes of microbial & plankton organisms which in turn sustain a wide array of higher trophic chains; consumers being mainly fish and waterfowl.

Even by January 88% of the tank waters were turbid. This clearly evidences serious soil erosion problems. 15 of the 97 tanks were dry probably due to successive silting over many years. 16% of tanks were heavily silted. 35% showed enough silting to support formation of mudflats and other serious problems like very poor shore vegetation and highly disturbed shore areas. Clear water was seen in just 12% of the tanks, 26% had above critical limits of dissolved solids. Effluents other than sewage entered 15% of the tanks. Green colour, eutrophication and Blue green algal dominance are closely related phenomena. 10% of tank waters showed green colour and 18% of them were dominated by blue green algae, detrimental for diverse productivity processes.

Conductivity levels in 30% and 10% of the tanks indicated moderate high nutrient enrichment.

Suitable desilting to encourage microhabitats of deep, moderate and shallow depths.

Management steps to support higher plankton diversity by allowing gradually sloping shores expansive catchment, grass with cover and vegetation organised agricultural/ horticultural activity and ideal tank bed profiles.

Prevention of aquatic vegetation dominated by Eichornia spp., a pollution indicator as this leads to slow succession of wetlands towards shallowness and also other spp. and cut off access to many shore and open waterfowl.

Shallow water aquatic vegetation should be maintained diverse. Species of fish tolerant to blue green algal dominance and for controlling mosquito larvae to be introduced.

Many other tanks no longer hold water having given way to other utilities not in any way related to wetlands.

There are only 16 tanks within city limits today compared to 140 in 1931 (Ravindra 1990). Built-up area has phenomenally increased and continues to do so rapidly for industrial, commercial, residential, public/civil amenities and transport facilities. This greatly blocks seepage of rain water to ground water reserves. Tanks have been lost. Water in existing tanks are unsafe. Thus water sources for existing sources are threatened.

In relation to wetlands these effects are all indirect, but of great consequence.

City's expansion should no longer be at the degenerative cost of wetlands; all existing ones have to be protected and preserved ecologically. Shore areas, catchment and watersheds should have both greening & waterfowl supporting features.

The Effects :

Indiscriminate mudlifting from the tank bed severely affects the tank ecosystem. The vertical walls of the pits lead to enormous silt movement once water starts flowing in during the rains. It renders water turbid, brings down the productivity of the tank affecting all aquatic organisms The vegetation is destroyed and even grass takes some time to re-establish itself in the drier portions. This affects livestock and cattle grazing and even feeding and breeding sites of birds.

There should be open and closed seasons for mudlifting compulsorily.

Brickmaking like mudlifting has reached rampant proportions. It has been recorded in 46% of the tanks in the tank bed area of immediate vicinity of th tank. Apart from neccesitating mudlifting for the purpose, brickmaking requires enormous amounts of firewood. Brickmaking activity should be prohibited within 1 km of the high water level mark used as a baseline ao that the wetland can be used by the birds.

Reclamation of the tank bed for uses detrimental to the well being of the tank can be termed encroachments. Apart from mud lifting and brickmaking activities, encroachments are basically for the purpose of agriculture.

Waterfowl, especially the migratory waterbirds which are present in our region from October to April are extensively hunted in our tanks. Actual recorded hunting and that revealed by local enquiries indicate that it is present in about 35% of the tanks.

Hunting of any kind disturbs the feeding, roosting and breeding birds of the habitat, as they are very sensitive to

sound and physical disturbance. Prolonged hunting in a given wetland might progressively drive them away from the site resulting in decreased number of birds in successive years.

Hunting of any kind needs to be stopped. The costs involved in hunting perunit weight of food would be much greater than perhaps growing domestic fowl. Existing laws for the preservation of wildlife which includes waterfowl should be given more publicity. On a large scale even the media could be made use of for the purpose. On a local scale, display boards with appropriate warnings and the benefits of having waterbirds visiting the area could be put up. Monitoring of selected tanks which hold potential should be taken up. Such sites should be declared as protected bird habitats.

Parallel efforts must be made to improve habitats ecologically to attract and sustain large numbers of waterfowl.

Presence of sewage and varied degrees of eutrophication have been recorded from 10% of the tanks, while 8% of the tanks had green waters showing high levels of algae and algal blooms. Other effluents are probably reaching 3% of the tanks.

Sewage alters the status of wetlands. It brings in enormous quantities of nutrients into the system and enables unregulated growth of algae. Both these raise BOD levels and also result in bad odours coming from the waters. It can also affect the growth of other flora and fauna(including fish and birds). Fish deaths under such conditions have been known earlier.

The quality of the water flowing in should be improved and bettered. BOD and suspended solids need to be brought to withiq acceptable limits. Inflow of untreated effluents need to be stopped. Indirect inflow of safe, treated effluents could be allowed only if they contribute significantly to the recharge of the tank waters.

Small low cost waste water handling facilities should be created for most seriously affected tanks on priority and in future for others for ecological and recreational improvement of habitats, avoiding this does not necessarily imply civil constructions.

There should be a decentralization of the sewage system and only treated sewage should be let out. Raw sewage should never reach the tanks directly, with monitoring of problems concerning pollution.

The ultimate aim should also be to bring under control, though it is a difficult process, the siltation of the tank. It is one thing to deepen the tank and another to try prevent silting itself. The afforestation of catchment areas would not only help in this regard but also meet the biomass needs for local uses. Funds earmarked for wasteland development, RLEGP, NREP, DPAP and also Jawahar Rozgar Yojana funds could be used for the purpose. Both the Mandal Panchayats and the Forest departments should be involved, the latter also in technical matters relating to afforestation. Along with silting, reduction of silt movement within the tank is also important. Reducing water inflow velocities while maintaining the inflow might help.

Since a variety of measures need to be tackled simultaneously, continuous information on annual changes regarding the status of shortlisted wetlands becomes most essential. Hence, monitoring of these habitats has to be taken up on a regular basis.

It probably suffices to conclude that the recommendations should be seriously implemented at the earliest. In view of our commitment towards the cause of wetlands and waterfowl, it has become supremely imperative to save and improve these resources for the progenies of nature.

Acknowledgements

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Ecological Evaluation of Irrigation Tanks in the Tiruvannamalai Sambuvarayar District of Tamil Nadu, India

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Introduction

Freshwater wetlands are fragile ecosystems but are fast deteriorating and shrinking (Maltby, 1986 and Dugan, 1990 and 1992). Though smaller freshwater irrigation tanks have great ecological and economic role, they are neglected. India has about 65,000 wetlands covering 4.5 million hectares (Anon, 1990). Though a few directories on wetlands have been published, all the wetlands have not been listed (Scott, 1989). A good number of works on wetlands in relation to birds have been done in India (Sampath, 1989; Sampath and Krishnamurthy, 1989, 1993; Vijayan, 1991). In this district hitherto no work on birds has been carried out. The present study was carried out for two seasons from December 1991 to March 1992 and from December 1992 to March 1993 with the aim of collecting baseline data on the ecology of irrigation tanks in the Tiruvannamalai Sambuvarayar district.

Material and Methods

The study area : Tiruvannamalai Sambuvarayar district is located (78° 69' E to 79° 78' E and 11° 96' N to 12° 90' N) at the northern part of Tamil Nadu State. Most part of the district is scattered with hilly terrains and with sparse dry deciduous forests. The average annual rainfall is 1040 mm. The bulk of the rainfall is from the northeast monsoon (October to December) and receives only scanty rainfall through the southeast monsoon (July to September).

Scattered throughout the district are about 1,900 tanks of both minor and major categories constituting about 10% of the geographical area. The area of the tanks range from 5 to 1.822 hac. Except a few tanks which are fed from the canals of the Sathanur dam, all others are rainfed. Barring a few tanks which are perennia, the remaining tanks are seasonal. Owing to heavy siltation the water storage capacity of all the tanks has been drastically reduced. From March/April to the onset of northeast monsoon (October) most of the tanks remain parched and are used for various activities like forestry operation, brickmaking, cattle grazing, etc.

Bird census was taken with a pair of binoculars (10 × 50) while walking over the bund of the tank. For bigger tanks, telescope (16 × 50 × 50 mm) was used. All the bird species encountered were enumerated. All the possible and assessable parameters like available natural vegetation, forestry plant species cultivated therein, extent of infestation by plant weeds, quality of water, magnitude of human encroachment, extent of reclamation of the tanks, agricultural crops cultivated around the tanks, nature of fishing, hunting and trapping of birds and tree cutting were recorded.

Results and Discussion

During the course of study, 350 tanks spread over an area of 23.391 ha were surveyed. The number of tanks in each taluk and the total area are given in Table 1.

Tanks above 100 hac are given below with the approximate area in hectares

A — Arani taluk		
1	Panaiyur	123
2	Thatchur	109
B — Chengam taluk		
3	Karapattu	149
4	Kariyamangalam	Above 100
5	Kolundampattu	Above 100
6	Munnurmangalam	106
7	Sathanur dam	1822
8	Thorapadi	162
C — Cheyyar taluk		
9	Alathur	104
10	Alivadaitangi	108
11	Anakkavoor	240
12	Anapathur	106
13	Chithathur	114
14	Dusimamandur	767
15	Echur	118
16	Kaliyar	103
17	Kovilur	132
18	Natteri	159
19	Nedungal	101
20	Pavoor	134
21	Perungattur	244
22	Purisai	184
23	Seeshamangalam (Mel)	268
24	Thennampattu	146
25	Thirumani	112
26	Ukkal	104
27	Vakkadai	187
28	Veerampakkam	148
D — Polur taluk		
29	Alliyalamangalam	106
30	Kalambur	104
31	Mandakolathur	142
32	Othalavadi	161
33	Peranambakkam	155
34	Sengunam	106
E — Tiruvannamalai taluk		
35	Samudram	155
36	Somasipadi	258
37	Sorakolathur	109
38	Su. Nallur	Above 100
39	Thenmathur	Above 100

F — Vandavasi taluk

40	Elangadu	204
41	Erumbur	142
42	Kolappalur	238
43	Namathodu	132
44	Nerkunam	145
45	Ponnur	137
46	Thennangur	107
47	Theyyar	158
48	Villivalavam	103

Official figures not available.

Bird Population

A total of 3,39,760 birds belonging to 65 species were recorded. But taluk wise, the maximum number of 59 species were recorded in Chengam followed by Cheyyar Taluk.

Species like Spotbilled Pelican, Whitenecked Stork and Glossy Ibis were recorded only in Chengam taluk. White Ibis was only in Cheyyar and Vandavasi taluks. Tufted duck was recorded only in Cheyyar taluk. The shorebird species like Whimbrel and Temminck's Stint were found in Chengam and Cheyyar taluks. Blackheaded Gull and Whiskered Tern were recorded only in Cheyyar and Vandavasi taluks. Little Tern was found only in Arani and Polur taluks.

Ducks constituted 47.98% among the total population of birds followed by shorebirds which formed 21.55%. The percentage composition of other major groups were egrets 13.42%, herons 4.73% and grebes 4.28%. In the remaining 8% were included the bird groups such as pelican, cormorant, storks, ibises, coots, gulls, terns bitterns, waterhen and watercoock.

Among the 9 species of ducks, the Pintail was quite dominant (70%) of the total ducks population of 1,66,768 birds recorded from 78 tanks. The Whistling Teal constituted the lowest population of 179 recorded only from Chengam taluk. Among the 26 species of shorebirds recorded, the Blackwinged Stilt was quite abundant, which constituted 43.77% among the total shorebird population of 70,811 birds recorded from 200 tanks. The other abundant shorebird species were Wood Sandpiper 13%, Little Ringed Plover 12% and Common Sandpiper 7%. The population of Terek Sandpiper was the lowest (80).

The Little Egret constituted 49% (out of the total population of 37,106 birds). The percentage composition of other 3 species Intermediate Egret, Cattle Egret and Greater Egret were 27% and 3%, respectively.

In herons, (4 species), the dominant species was Pond Heron which constituted 85% (out of the total population of 14,119 birds). This species was recorded from 310 tanks. The minimum population was of Purple Heron (0.35%), recorded only on 11 tanks.

Among the three species of storks, the population of Openbill Stork was the highest with the population of 369 birds. The percentage compositions of Cormorants and Darter were 2.34% and 0.35% respectively. Of the 74 tanks, where Cormorants were found, maximum population of 2,800 birds was recorded in Dusimamandur tank in Cheyyar taluk. Darter was recorded in 13 tanks with maximum population (60) in Dusimamandur tank.

Among the six taluks, the density of birds was the highest in Polur taluk with 33.35 birds. It was the lowest (8.77 birds) in Arani taluk (Table 1).

The common threats to which the tanks are exposed are given below:

Nearly 70% of the tanks were infested with exuberant growth of weeds like *Prosopis juliflora*, *Ipomoea aquatica* and *Sagittaria* sp. The growth of natural vegetation was suppressed by the invasion of weeds that accelerated the eutrophication process.

Siltation and decrease in water storage capacity of almost all the tanks is believed to be due to deforestation.

In about 80% of the tanks, agriculture is being done around the tanks. The quantum of chemical fertilizer used annually was 5,1000 tonnes and the pesticides used was over 500 tonnes. It is feared that large scale utilization of chemical products would have upset the tank ecosystem and still the damage may be continuing.

All the tanks are subjected to hunting and trapping of birds and disturbance due to fishing, cattle grazing, firewood cutting, etc.

The record of minimum number of 22 species in Odalavadi tank may be due to the over abundance of weeds and forestry plantation (Reddy, 1988). Forestry operation deteriorates tanks UNESCO.

Greater composition (47.98%) of ducks in the estimated total population could be attributed to their preference of wide variety of habitats as vast open area, abundant submerged vegetation and plenty of benthic organisms (Vijayan, 1991). Such a preponderant abundance of ducks recorded in the present study corroborates with the study conducted on the coramandal coast by Perennou and Santharam (1990).

Among the 9 species of ducks, sighting of only Pintail in more number (78) of tanks could be due to its survivability in wide variety of habitats. It has been reported that this species feeds both on plant and animal matter (Vijayan, 1991).

It is imperative to extend protection measures to all the wetlands irrespective of the size (SCOPE, 1972). The smaller wetlands also have ecological value (tanks with less than 100 ha are 303, Table). In the present study it was found that a total of 49 tanks with less than 100 ha had population of 91,733 ducks. So effective conservation measures should be initiated to protect all the wetlands irrespective of the size.

Apart from siltation, the other causative factors for the deterioration of tanks in this district are deforestation, infestation by weeds, overgrazing by livestock, wrong agricultural practice and agricultural pollutants (Agricultural Officer Pers. Comm.). These are the major factors which

cause deterioration of wetlands all over the world (Parish and Prentice, 1989).

For the restoration of the irrigation tanks in this district and conserve birds these should be checked.

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Table 1 : Number of tanks surveyed, total area, total number and density of birds in each taluk

Taluks	Number of tanks	Total area of tanks (ha)	Number of species	Total bird population	Density of birds
Arani	63	2697	46	23657	8.77
Chengam	48	4762	59	76400	16.04
Cheyyar	137	8516	58	101348	11.90
Polur	37	2451	41	81751	33.35
Tiruvannamalai	36	2356	41	27371	11.62
Vandavasi	29	2609	50	29233	11.20

Avifaunal Decline in a Newly Formed Extension of Bangalore City

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The city of Bangalore has been expanding rapidly. The march of urbanization has had deleterious effects on the avifauna of Bangalore (Verghese *et al.*, 1976). Records from roving survey to a newly formed extension on the West of Bangalore beyond Rajajinagar, between 1975 and 1980 and 1990 and 1993, are given in Table 1. This comprises approximately 25% of the total avifauna of Bangalore. Some observations were also recorded between 1980 and 1990.

Prior to 1980, this area of about 100 hectares was open scrub land, with rainfed cultivation. A sewage cuts through this, which at one point widened into an open swamp of nearly two hectares. There were scattered small woodlands with trees of *Casuarina, Pongamia glabra, Ficus, Eucalyptus*, etc. During the eighties, this area was reclaimed and converted into residential sites. Today, it is characterized by urban built-up areas with humans, roads, vehicles and noise. In addition, the pollution effect of the Peenya Industrial Estate is felt here.

As a result of urbanization, the avifaunal decline has been drastic by nearly a loss of 55% (Table 1) species of birds. Birds intolerant to urbanization (Verghese *et al.*, 1976) and which are habitat specific have disappeared such as Bluethroat, Streaked Fantail Warbler, Baybacked Shrike, Ashycrowned Finch-Lark, Pale Harrier, Grey Partridge, Blackwinged Kite, etc. There are certain birds, which tolerate external influence of urbanization (Verghese *et al.*, 1976) which can be saved by conserving pockets of habitats, like for example, the Grebe, Coot, Purple, Moorhen, Sandpipers, Wagtails, Small Blue Kingfisher and so on. With the march of urbanization, birds are pushed out, like for example, the Redheaded Merlin ()the first record of the bird from Karnataka was from this locality, Govindakrishnan *et al.*, 1978) which nested here in 1980s and has now abandoned this area for ever. The requence in which birds disappeared was observed. In 1980, when trees were felled, the barbets, Koel, Coppersmith, Sunbird, Flowerpecker and Oriole abandoned the area. In 1984, when the Government took over most of the cultivated patches, for construction of buildings, Lapwings, Shrikes, Bulbuls, Warblers and Flycatchers disappeared. During 1988 when intense human use of the vast expenses of open spaces in the area begán, Owls, Larks, Bluethruat and Pipits vanished.

The stream and the swamp habitats of birds were encraoched upon during 1990 when a survey indicated absence of Herons, Grebes, Egrets, Moorhen, Sandpiper, Fantail Snipe and Kingfishers. In 1992 when the entire area was heavily used, birds that moderately tolerated urban set-up like Doves, Bee-eaters, Horpoe, Quails,Patridges and Vultures declined.

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This note is to emphasise the need to check march of urbanization habitats like swamps, woods, openlands and scrubs. It is urged here to allow urban development, if inevitable, only around protected pockets, so that atleast

Table 1 : Presence–absence of birds in the outskirts of Rajajinagar, Bangalore

	Name of the Bird		Present (+)/Absent (–)	
	Common name	Scientific Name	1975–1980	1990–1992
1	Grebe	*Podiceps rufficollis*	+	–
2	Grey Heron	*Ardea cinerea*	+	–
3	Pond Heron	*Ardeola grayli*	+	+
4	Cattle Egret	*Bulbulcus ibis*	+	–
5	Little Egret	*Egretta garzetta*	+	+
6	Night Heron	*Nycticorav nycticorax*	+	–
7	Blackwinged Kite	*Elanus caeruleus*	+	–
8	Pariah Kite	*Milvus migrans*	+	+
9	Shikra	*Accipiter badius*	+	–
10	Whiteeyed Buzzard-Eagle	*Butastur teesa*	+	–
11	Whitebacked Vulture	*Gyps bengalansis*	+	+(F)
12	White Scavenger Vulture	*Neophron percnopterous*	+	+(F)
13	Pale Harrier	*Circus macrourus*	+	–
14	Redheaded Merlin	*Falco chicquera*	+	+(F)
15	Kestrel	*F.tinnunculus*	+	+(F)
16	Grey Partridge	*Francolinus pondicerianus*	+	–
17	Grey Quail	*Coturnix coturnix*	+	–
18	Jungle Bush Quail	*Perdicula asiatica*	+	–

	Name of the Bird		Present (+)/Absent (–)	
	Common name	Scientific Name	1975–1980	1990–1992
19	Whitebreasted Waterhen	*Amouromis phoenicurus*	+	–
20	Indian Moorhen	*Gallinula chloropus*	+	–
21	Purple Moorhen	*Porphyrio porphyrio*	+	–
22	Coot	*Fulica atra*	+	–
23	Redwattled Lapwing	*Vanellus indicus*	+	+ (H)
24	Yellow-wattled Lapwing	*V.malabaricus*	+	–
25	Spotted Sandpiper	*Tringa glareola*	+	+
26	Common Sandpiper	*T.hypoleucos*	+	–
27	Fantail Snipe	*Gallinago gallinago*	+	–
28	Blue Rock Pigeon	*Columba livea*	+	+
29	Spotted Dove	*Streptopelia chinensis*	+	+
30	Roseringed Parakeet	*Psittacula krameri*	+	+
31	Piedcrested Cuckoo	*Clamator jacobinus*	+	–
32	Koel	*Eudynamus scolopoceae*	+	+
33	Crowpheasant	*Centropus sinensis*	+	–
34	Spotted Owlet	*Athene brama*	+	+
35	Brown Fishowl	*Bubo zeylonensis*	+	–
36	Nightjar	Caprimulgus asiaticus	+	+ (H)
37	Great Horned owl	*Bubo bubo*	+	–
38	House Swift	*Apus affinis*	+	+
39	Pied Kingfisher	*Ceryle rudis*	+	–
40	Small Blue Kingfisher	*Alcedo athis*	+	–
41	Whitebreasted Kingfisher	*Halcyon smyrnensis*	+	+ (Rare)
42	Small Green Bee-eater	*Merops orientail*		
43	Roller	*Corcais benghalensis*	+	–
44	Green Barbet	*Megalaima viridis*	+	+
45	Crimsonbreasted Barbet	*M.haemacephala*	+	+
46	Hoopoe	*Upupa epops*	+	–
47	Singing Bush Lark	*Mirafra javanica*	+	–
48	Ashycrowned Finch Lark	*Erempoterix grisea*	+	–
49	Redrumped Swallow	*Hirundo daurica*	+	+ (F)
50	Wiretailed Swallow	*H.smithii*	+	+ (F)
51	Common Swallow	*H.rustica*	+	+ (F)
52	Baybacked Shrike	*Lanius vittatus*	+	–
53	Brown Shrike	*Lanius cristatus*	+	–
54	Indian Oriole	*Oriolus oriolus*	+	+
55	Black Drongo	*Dicrurus adsimilis*	+	+
56	Brahminy Myna	*Sturnus pagodarum*	+	–
57	Common Myna	*Acridotheres tristis*	+	+
58	Jungle Myna	*A.fuscus*	+	+
59	Wood Shrike	*Tephrodornis pondicerianus*	+	–
60	House Crow	*Corvus splendens*	+	+
61	Jungle Crow	*C.macrorhyhchos*	+	+
62	Blackheaded Cuckoo Shrike	*Coracina melanoptera*	+	–
63	Iora	*Aegithina tiphia*	+	–
64	Redvented Bulbul	*Pycnonotus cafer*	+	+
65	Whiteheaded Babbler	*Turdoides affinis*	+	–
66	Redbreasted Flycatcher	*Culicicapa parva*	+	–
67	Streaked Fantail Warbler	*Cisticola juncidis*	+	–
68	Ashy Wren-Warbler	*Prinia socialis*	+	+
69	Tailor Bird	*Orthotormus sutorius*	+	+
70	Blyths Reed Warbler	*Acrocephalus dumetorum*	+	–
71	Leaf Warbler	*Phylloscopus affinis*	+	+
72	Bluethroat	*Erithacus srecicus*	+	–
73	Magpie Robin	*Copsychus saularis*	+	–
74	Pied Bush Chat	*Saxicola caprata*	+	+
75	Indian Robin	*Saxicoloides fulicata*	+	–
76	Grey Tit	*Parus major*	+	–
77	Indian Pipit	*Anthus novaseelandae*	+	–
78	Yellow/Grey Wgatail	*Motacilla* spp	+	–
79	Pied Wagtail	*M.maderaspatensis*	+	+
80	Tickell's Flowerpecker	*Dicaeum erythrorhynchos*	+	–
81	Purple Sunbird	Nectarinia asiatica	+	–
82	Purplerumped Sunbird	*N.zeylonica*	+	+
83	White-eye	*Zosterops palpebrosa*	+	+

	Name of the Bird		Present (+)/Absent (–)	
	Common name	Scientific Name	1975–1980	1990–1992
84	Baya	*Ploceus philippinus*	+	–
85	Red Munia	*Amandava amandava*	+	–
86	Whitethroated Munia	*Lonchura malbarica*	+	–
87	Whitebacked Munia	*L. striata*	+	–
88	SpottedMunia	*L.punctulata*	+	+
89	Blackheaded Munia	*L.malacca*	+	–
90	House Sparrow	*Passer domesticus*	+	+

birds which tolerate external influence of urbanization can be saved from local extinction.

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Wild Bird Trade in Bangalore City

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Through surveys and interviews conducted at monthly intervals from October 1992, it was found that 28 species of native, and six species of exotic birds are being sold in Bangalore city. It was found that the trade was traditional and has been practiced for many generations. The bird traders have a great knowledge of birds and are aware of their food and nesting habits, distribution, rarity, etc. the native species include 4 species of Parakeets, 5 species of Munia and 3 species of Mynas, 2 species of Quailes, 3 birds of prey and others.

The birds are being priced according to their colour and rarity. The prices vary from Rs 5 per Munia to Rs 10,000 for a Shaheen Falcon. The peak season for the trade of birds is from October to December, during this period on an average 50 birds are sold per day. During the other months, an average, of 20-25 birds are sold per day.

It was found that Parakeets were being bought as pets and partly for astrological purposes. Pigeons and Doves are bought and sacrificed in religious and medical grounds. Doves, Munias, Mynas etc are commonly kept as pets. It is interesting to note that there is a demand for Farm Owls for the control of agricultural pests. Sometimes Quailes, Partridges and even Peafowl are bought for the table.

Pigeons and Budgerigars are the only ones that breed in captivity here. The rest are wild birds that are caught mainly from the nest. The birds are supplied from the Western Ghats and other parts of south India.

It was mentioned that birds are caught from as far as Orissa and Bihar. On transit on an average 80%of she birds suffered mortality. The rest that are sold,often die in the hands of a new owner who is ignorant of its needs. The maintenance of these birds in the market is unhealthy and appalling.

Endangered birds like Spotbilled pelican are sometimes caught and offered for sale in the market. The Red breasted and Alexandrine parakeet and Black crested baza were found under dilapidated conditions. These are rare species introduced through trade in Bangalore. So far there has been practically no agency or conservation measures being adopted against birds in the trade.

The raids conducted by the Forest Department and other agencies do not help in rehabilitating the birds. Even if the birds are confiscated, they are often released in places hostile to birds.

As part of their culture, some communities buy and release birds birds en masse. This does more harm than good as it increases the demand for wild birds. The only solution to stop the wild bird trade in Bangalore is making people aware of the consequences of buying wild caught birds.

Birds of Annamalai Hill

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The first half of Annamalai Hill in the Indira Gandhi Wildlife Sanctuary is well documented for its bird life as it is the main tourist zone. 'Top slip' lies in this area. Top slip elevation is only around 2500 feet and its forests are shrub and dry deciduous with a few exemptions like karian shola. Water is very scarce in summer.

In the middle portion of the hill where Valparai town is situated, tea is extensively cultivated in about 55,000 acres. There are few cardamom and coffee estates. The rainfall is around 350 cm. The large scale feelings in private natural forests and conversion of Cinchona plantations into tea is posing a real threat to the rich bird life of this area.

The top portion of the hill where the famous Grass hills lies, is in no way comparable to the other two zones. It extends from 5500 feet to 8000 feet with rolling wind swept grass covered hills, sholas, riverine forests with hundreds of perennial streams and swamps. The rainfall is above 500 cm and the whole place is covered with mist for 4 months from June to September. Due to this, bird life is abundant.

A list of birds sighted here are given below :

1	Little Cormorant,	*Phalacrocorax niger*
2	Pond Heron	*Ardeola grayii*
3	Little Egret,	*Egretta garzetta*
4	Chestnut Bittern,	*Ixobrychus cinnamomeus*
5	Black Bittern,	*Ixobryehus flavicollis*
6	Blackwinged Kite,	*Elanus caeruleus*
7	Pariah Kite,	*Milvus migrans*
8	Brahminy Kite,	*Haliastur indus*
9	Shikra,	*Accipiter badius*
10	Black Eagle,	*Retinaetus malayensis*
11	Pale Harrier,	*Circus macrourus*
12	Crested Serpent Eagle,	*Spilornis cheela*
13	Indian Black Crested Baza,	*Aviceda leuphotes*
14	Kestrel,	*Falco tinnunculus*
15	Painted Bush Quail,	*Perdicula erythrorhyncha*
16	Red Spur Fowl,	*Galloperdix spadicea*
17	Button Quail,	*Turnix tank*
18	Whitebreasted Waterhen,	*Amaurornis phoenicurus*
19	Kentish Plover,	*Charadrius alexandrinus*
20	Woodsnipe,	*Gallinago nemoricola*
21	Woodcock*,	*Scolopax rusticola*
22	Orangebreasted Green Pigeon,	*Treron bicinta*
23	Green Pigeon,	*Treron phoenicoptern*
24	Imperial Pigeon,	*Ducula badia*
25	Spotted Dove,	*Streptopelis chinensis*
26	Emerald Dove,	*Chalcophaps indica*
27	Rufous Turtle Dove,	*Streptopelia orientalis*
28	Roseringed Parakeet,	*Psittacula krameri*
29	Bluewinged Parakeet,	*Psittacula columboides*
30	Indian Lorikeet,	*Loriculus beryllinus*
31	Indian Plaintive Cuckoo,	*Caeomantis passerinus*
32	Koel,	*Eudynamys seolopacea*
33	Crow Pheasant,	*Centropus sinensis*
34	Cuckoo,	*Cuculus canorus*
35	Jungle Owlet,	*Glaucidium radiatum*
36	Mottled Woodowl,	*Strix oceallata*
37	Forest Eagle-Owl,	*Bubo nipalensis*
38	Longtailed Nightjar,	*Caprimulgus macrurus*
39	Indian Edible Swiftlet,	*Collocalia unicolor*
40	Brownthroated Spinetailed Swift,	*Chaeturn gigantea*
41	Indian Alpine Swift,	*Apus Melba*
42	Malabar Trogon,	*Harpactes fasciatus*
43	Pied Kingfisher,	*Ceryle rudis*
44	Blue-eared Kingfisher,	*Alcedo meninting*
45	Storkbilled Kingfisher,	*Pelargopsis capensis*
46	Whitebreasted Kingfisher,	*Halcyon smyrensis*
47	Chestnutheaded Bee-eater,	*Merops leschenaultii*
48	Small Green Bee-eater,	*Merops orientalis*
49	Bluebearded Bee-eater,	*Nyctyornis athertoni*
50	Indian Roller,	*Coracias benghalensis*
51	Broadbilled Roller,	*Eurystomus orientalis*
52	Hoopoe,	*Upupa epops*
53	Malabar Grey Hornbill,	*Toekus griseus*
54	Great Pied Hornbill,	*Buceros bicornis*
55	Small Green Barbet,	*Megalaima viridis*
56	Crimsonthroated Barbet,	*Megalaima rubricapilla*
57	Speckled Piculet,	*Picumnus innominatus*
58	Goldenbacked Woodpecker,	*Dinopium benghalense*
59	Indian Goldenbacked Threetoed Woodpecker,	*Dinopium javaneuse*
60	Large Goldenbacked Woodpecker,	Chrysocolaptes *lacidus guttacristatus*
61	Indian Pitta,	*Pitta brachyura*
62	Malabar Crested-Lark,	*Galerida malabarica*
63	Dusky Crag Martin,	*Hirundo rupestris*
64	House Swallow,	*Hirundo tahitien*
65	House Martin,	*Delibon urbien*
66	Rufousbacked Shrike,	*Lanius schah*
67	Brown Shrike,	*Lanius cristatus*
68	Golden Oriole,	*Oriolus oriolus*
69	Blackheaded Oriole,	*Oriolus xanthornus*
70	Black Drongo,	*Dicrurus adsimilis*
71	Whitebellied Drongo,	*Dicrurus caerulescens*
72	Bronze Drongo,	*Dicrurus aeneus*

73	Greater Racket-tailed Drongo,	*Dicrurus paradiseus*
74	Ashy Swallow Shrike,	*Artamus fuscus*
75	Greyheaded Myna,	*Sturnus malabaricus*
76	Blyth Myna,	*Sturnus malabaricusblythi*
77	Common Myna,	*Acridotheres tristis*
78	Jungle Myna,	*Acridotheres fuscus*
79	Hill Myna,	*Gracula religiosa*
80	Southern Tree Pie,	*Dendrocitta leucogastra*
81	Indian Tree Pie,	*Dendrocitta vagabunda*
82	House Crow,	*Corvus splendens*
83	Jungle Crow,	*Corvus macrorhynchos*
84	Pied Flycatcher-Shrike,	*Hemipus picatus*
85	Large Wood Shrike,	*Tephrodornis virgatus*
86	Blackheaded Cuckoo Shrike,	*Coracina melanoptera*
87	Malabar Small Minivet,	*Pericrocotus cinnanom*
88	Orange Minivet,	*Pericrocotus flammeus*
89	Common Iora,	*Aegithina tiphia*
90	Fairy Blue Bird,	*Irena puella*
91	Goldfronted Chloropis,	*Chloropsis aurifrons*
92	Rubythroated Bulbul,	*Pycnonotus melenicterus*
93	Redwhiskered Bulbul,	*Pycnonotus jocusus*
94	Redvented Bulbul,	*Pycnonotus cafer*
95	Yellowthroated Bulbul,	*Pycnonotus xantholaemus*
96	Yellowbrowed Bulbul,	*Hypsipetes indicus*
97	Black Bulbul,	*Hypsipetes madagascariensis*
98	Spotted Babbler,	*Pellorneum ruficeps*
99	Slatyheaded Scimitar Babbler,	*Pomatorhinus hursfieldii*
100	Blackheaded Babbler,	*Rhopcichla atriceps*
101	Common Babbler,	Turdiodes caudatu
102	Rufous Babbler,	*Turdiodes subrufus*
103	Quaker Babbler,	*Alcippe poioicephala*
104	Palani Laughing Thrush,	*Garrulax jerdoni*
105	Brown Flycatcher,	*Muscicapa muttui*
106	Black and Orange Flycatcher,	*Muscicapa nigrorufa*
107	Whitebellied Blue Flycatcher,	*Muscicapa allipes*
108	Verditer Flycatcher,	*Muscicapa thalassina*
109	Nilgiri Verditer Flycatcher,	*Muscicapa albicaudata*
110	Greyheaded Flycatcher,	*Culicicapa ceylonensis*
111	Paradise Flycatcher,	*Terpsiphone paradisi*
112	Blacknaped Flycatcher,	*Hypothymis azurea*
113	Tailor Bird,	*Orthotomus sutorius*
114	Broadtailed Grass Warbler,	*Schoenicola platyura*
115	Large Billed Leaf Warbler,	Phylloscopus *magnirostris*
116	Large Crowned Leaf Warbler,	*Phylloscopus occipitalis*
117	Ashy Wren Warbler,	*Prinia socialis*
118	Magpie Robin,	*Copsychus saularis*
119	Pied Bush Chat,	*Saxicola caprata*
120	Indian Robin,	*Saxicoloides fulicata*
121	Malabar Whistling Thrush,	*Myiophonous horsfieldii*
122	Whitethroated Ground Thrush,	*Zoothera citrana*
123	Black Bird,	*Turdus merula*
124	Bourdilloni Black Bird,	*Turdus merula bourdilloni*
125	Grey Tit,	*Parus major*
126	Yellowcheeked Tit,	*Parus xanthogenys*
127	Velvetfronted Nuthatch,	*Sitta frontalis*
128	Nilgiri Pipit,	*Anthus nilghiriensis*
129	Grey Wagtail,	*Motacilla caspica*
130	White Wagtail,	*Motacilla alba*
131	Large Pied Wagtail,	*Motacilla maderaspatensis*
132	Thickbilled Flowerpecker,	*Dicaeum agile*
133	Tickells Flowerpecker,	*Dicanum erythrorhynchos*
134	Small Sunbird,	*Nectarina minima*
135	Indian Purple Sunbird,	*Nectarina asiatica*
136	Little Spiderhunter,	*Arachnothere longirostris*
137	Whiteeye,	*Zosterops palpebrosa*
138	Rufousbellied Munia,	*Lonchura kelaarti*
139	House Sparrow,	*Passer domesticus*
140	Rosefinch,	*Carpoduces erythrorhynchos*

* Seen only the tell tale marks on the river banks in the Grass Hills

BIOLOGY and BEHAVIOUR

A Look at the Cooperative Breeding Strategies in Small Green Bee-eaters (*Merops orientalis*) in Southern India

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Introduction

The Bee-eaters belong to family Meropidae, which are alert and vivacious birds, distributed in tropical old world. They specialize in catching bees and related hymenopterans. Of the 24 species of bee-eaters in the world, 11 are reported to exhibit seemingly cooperative breeding behaviour (Fry, 1984).

Since 1935, lot of scientific studies have been carried out on cooperative breeding in birds and mammals. Alexander Skuth studied helping at the nest in 1935, followed by Rowley (1965) on Superb Blue Wren, Fry (1972) on Red-throated Bee-eaters, Parry (1973) on Kookaburra, Zahavi (1974) on Arabian Babbler, Ligon and Ligon (1978) on Green Wood-hoopoe, Emlen (1981) on Whitefronted Bee-eater. Over 300 species of birds are known to exhibit cooperative breeding behaviour . In co-operative breeding birds,typically an auxiliary (non-breeding adult) assists the breeding pair physically but not genetically in rearing their young (Emlen, 1986).

Some behavioural ecologists call it 'paradoxical behaviour' since such an altruistic behaviour is opposite to the action of selection (Gadakar, 1991). An altruistic act is one that confers benefit on someone at a cost to the helper, since cost is measured by decrease in reproductive success, we know that altruistic acts are opposed by natural selection working on the actor (Trivers, 1988). The most important conceptual advance in an attempt to explain such paradoxical behaviour came in the theory of Kin selection or inclusive fitness (Hamilton, 1964). The central idea in Hamilton's theory is that fitness comes not only from rearing for ones' offsprings but may also come from caring for one's genetic relatives. In other words, altruistic is not paradoxical, it is also nepotistic, i.e., directed preferentially towards genetic relatives (Gadakar, 1991).

The Small Green Bee-eater (SGB) *Merops orientalis* is one of the five cooperatively breeding birds known in India up till now (Table 2). They have eight races, easily the most geographically variable among bee-eaters exhibiting little plumage variation.

Small Green Bee-eater is common in open cultivated fields. They nest on banks by canals and ravines, sandy river banks and bunds, and gently sloping bare grounds around cultivated tracts. The SGB's nest in loose colonies, normally the distance between any two nest is more than 10 m. The nesting season around Bangalore is from February to August, with peak breeding around April–May.

Only one helper is seen with a pair, arriving normally after the completion of nest excavation or beginning of incubation and stay with the breeding pair, even after the chicks have fledged. With this background, the present investigation was undertaken.

Material and Methods

We intensively studied the breeding behaviour of the Small Green Bee-eater *Merops orientalis*, in GKVK Campus of the University of Agricultural Sciences in North Bangalore (13°N 77°E; altitude 930 m) and some nests were also studied around Bangalore.

A total of 24 pairs were observed for three years during breeding months from 1990 to 1992. Three typical nests were selected for detailed studies, while the other 21 nests were observed during week ends. Individual birds visiting the nest were marked using indelible nontoxic dye, for identification. Data on breeding success of 24 nests (9 with helpers) and frequency of food provisioning by parents and helpers in nests with and without helpers were also collected (Table 1). Detailed records on behaviour were kept on all the individuals of the typical nests. Correlation between rainfall received prior to the nesting season, and breeding success in nests with and without helper, were also attempted. A pair of 7 x 50 binoculars and a camera with 300 mm lens were used. Most of the observation were made from a hide during week ends. However the typical nests were monitored daily for 2 hours right from the period of nest site selection, till the chicks fledged and also for six weeks after fledging in one particular instance.

Data on the breeding cycle, duration of nest digging, incubation, feeding the chicks, feeding the fledglings were maintained. The average duration of each stage was taken for determining the peak breeding periods in different years

Results and Discussion

Of the 24 nests monitored, 9 (or 40%) had one helper each making a breeding unit of three adults or trios. In one instance the same individual was seen helping the breeding pair at the same site in two consecutive years 1990 and 1991 thus, suggesting natal philopatry in helpers. Normally the nest digging activity commenced around the middle of February and excavation was completed in 15 to 20 days.

There after, a lag period of 5 to 10 days was noticed before the eggs were laid and incubation started. The period of incubation varied between 20 to 25 days. The helpers normally arrived only after the commencement of incubation and assisted in incubation feeding the breeding female and feeding the nestlings (Table 1). They vocalized and interacted with the breeding pair and thechicks. It was also seen feeding the fledglings nearly 6 weeks after they had left the nest. In the typical nest where helper philopatry

was observed, the helper was seen preferentially feeding a particular fledgling. The period of feeding at nest lasted around 25 days, subsequently the fledglings started emerging from the nest.

It was noticed that in the nest with a helper, the nestlings grew rapidly and all the chicks fledged within(2.25+/-1) days, whereas in an unhelped nest the chicks were at differential stages of development, hence the fledging period (the time period between the first and the last chick emerging out of the nest) was significantly higher (4.6+/-1) days (Mann-Whitney U test, P=0.02). On an average the nests with a helper fledged more number of chicks (6.5+/-1), compared to (5+/-1) in nests without a helper (Mann-Whitney U test, P=0.05). None of the nests helped were predated, while 20% of those without helpers suffered predation, suggesting that nests without a helper had a higher probability of being predated (G-test of independence,P,< 0.05). Breeding cycle lasted longer in nests without a helper, compared to nests with helper. The frequency of feeding newly hatched brood at the nests with helper was more(14.75 visits/h vis-a-vis 10.5 visits/h, Mann-Whitney U test, P= 0.05), consequently the food provisioning by each parent was less in such nests(4.92 visits/bird vis a vis 5.25 visits/bird).

The breeding cycle lasted from February to August and most of the fledglings had emerged by June to coincide with the onset of South West monsoon. Peak nesting activity was around April. In three year study, we noticed that the nests initiated following poor monsoon (RFzmm) were more likely to receive help compared to nests initiated following good rains (RF890) (chi-square=7.8, df= 1, P<0.05) (See table 3).

Benefit to the Breeders

Helpers contribute to survival of the breeding pair's offsprings in two principal ways (i) by providing better food provision than that can be provided by the breeding parents only (ii) by providing better protection from predators (Emlen, 1986).

The increase in breeding success, was due to increase in number of chicks fledged .The increased fledgling success in nests with helpers was due to provisioning contribution of the helper. Helper also had an added influence on the survival of nestlings to fledglings. Young, from helped nest were less retarded and had significantly higher post fledgling survival to the age of independence (Emlen, 1991).

The presence of helper may also aid the breeding pair in better detection of predators and increased intensity of anti predatory activity like mobbing, there by reducing nesting failure caused by predation.

The pair with a helper is in better condition, therefore can breed more effectively in the next term. The helper also appears to decrease the chance that the breeder dies that year (Wolfenden, 1981). The presence of helper probably reduces the cost to the breeding pair of annual nesting thereby increasing the pairs potential reproduction record (Ligon and Ligon, 1982). In many species of cooperative breeders the presence of helpers allows the breeder to reduce their workload (Brown, 1987).

The probability of the breeding pairs preference for brood succession is high in nest with a helper as the breeding period per clutch is decreased in nests with helper and also the parents are in better condition to breed again within the same season which is fairly lengthy (February-September). Auxiliaries feeding of nestling and fledgling probably reduced the energetic burden on the principal, contributes to renesting by the female after the successful nesting (Rabinold, 1984). However, the prolonged weaning period in bee-eater (12 weeks) may not allow female to renest as ideal conditions by September end will be restricted.

However Emlen and Wrege (1992) observed that older pairs disrupt the nesting of their own sons and recruit them as their nest helpers. In this parent-offspring conflict he feels that the offsprings oblige the parents by becoming their helpers. They have also remarked that continued association between parents and grown offsprings (or other close relatives) entails various costs and benefits to both the parties.

Evolution of Cooperative breeding

Cooperatively breeding species generally face some form of ecological or demographical constraints. These constraints prevent some individual from attaining breeding status or raise the cost of independent breeding to prohibitive levels. The exact form of constraint varies from species to species, but the end result is that a grown up offspring may delay dispersal and remain as nonbreeder in the natal clan (Ecological constraint model, Emlen,1982).

In case of SGB's, a high population density and saturation of all good-quality foraging habitat seems to be one of the major ecological constraints. With no good-quality and hardly any marginal-quality habitat left unoccupied, some prospective first- time breeders will be denied adequate feeding territory and hence nesting opportunity. Under such a situation it pays to remain in the safety of the natal territory and wait for breeding opportunity to open up (natal philopatry). In regions where the climate is irregular and habitat quality fluctuates erratically a given density of birds will have breeding opportunities opening up and closing. Moreover a non-breeder may have better chance of survival if they associate with the breeding pair, because they may gain directly from group living (Emlen, 1986). Two most often cited benefits are increased alertness and defense against predators and increased capabilities for detecting and harvesting food resources that are difficult to locate (Bertram, 1978).

This has been observed in our study area, the frequency of helping was high following poor rainfall, when breeding opportunities are limited and the helpers will have less probability of success if they attempt to breed on their own.

Though the Ecological constraint model explains natal philopatry, it fails to explain as to why a non-breeder indulges in the costly act of helping? The probable cause of helping once the non-breeder remains in the natal territory could be the direct and indirect benefit of helping.

Benefit to Helpers

Helpers gain indirect inclusive fitness by aiding close relatives (Hamilton, 1964). In most of the cooperatively

breeding birds it is often seen that the helper belongs to the previous brood of the breeding pair it is helping. Just as natural selection favours traits that increase an individuals, production of surviving offsprings, because parent and offsprings are genetically related, so natural selection also favours traits that increase the survival of other categories of relatives such as siblings and cousins.

If the helper outlives the breeder of its own sex in the flock it may inherit breeder status. Therefore by helping, a helper increases the probability of becoming a breeder in future (Ligon & Ligon, 1978).

Helpers, when they turn breeder could recruit helpers from the nest they had helped in past to defend its present territory or take over adjoining territory (Reciprocal altruism, Ligon & Ligon, 1982). This explanation seems to be of significance since we observed one particular helper preferentially feeding a particular fledgling from a group after they had fledged.. Alternatively the helper might have parasitized the nest with its own egg and recognized its own offspring perhaps through acoustic cues (Emlen, 1992 pc).

Helpers with past experience have more nesting success. Therefore gaining breeding experience at some else's cost may be one of the benefits of helping behaviour. If experienced, their apprenticeship in the art of rearing young may serve to improve their own reproductive performance.

In cooperative breeding birds which nest in tunnels and form loose clans in breeding season like Whitefronted Bee-eaters (Emlen and Wredge, 1988), Red throated Bee-eater (Fry, 1984), Pied Kingfisher (Reyer, 1980) and our observations in Small Green Bee-eaters, food is the limiting factor; as a consequence, increase in number of helpers decrease both the probability of nest starvation and the degree of nestling developmental retardation due to food stress. Here predation does not seem to be a major problem. But in case of the cooperative breeding species which are ground foragers and social in nature forming small groups throughout the year called social units, such as Wood Hoopoes (Ligon & Ligon, 1982), Florida Scrub Jay (Wolfenden and Fitzpatrick, 1984), Stripebacked Wren (Rabinold,. 1984), Arabian Babbler (Zahavi, 1976), the presence of helpers improve the reproductive success principally by reducing nestling failure which is almost always caused by predation. Here feed rate is not the major cause of nestling loss and variation in nestling success. But, predation does influence success. Helpers contribute to nest success by directly reducing nest predation probably through improved predator detection and increased intensity of predator mobbing or indirectly by taking over the burden of feeding of nestling and fledgling which frees the principal male to defend the nest better (Rabinold, 1984).

Our study has revealed that in the Small green bee-eater almost 40% of the breeding pairs are assisted by a solitary helper, which takes part in all nesting activities except excavation. In such cases the duration of the nesting cycle is considerably reduced and the number of fledlings are more. It was also observed that nests with helpers were more during season that followed poor monsoon than those following normal rainfall. Out study of the cooperative breeding among Small Green Bee- eaters has opened a valuable insight into the evolutionary origin of helping behaviour among birds as a whole. We feel that taking a closer look at SGBs as well as other Indian bee-eaters is be essential to evaluate fully the relative role of Kinship, demographic constraints and other explanations for the existance of cooperation.

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Table 1 : Contribution of individuals at a nest with helper

Sl.No.	Activity	Male	Female	Helper
		(in percentage)		
1	Excavation	50	50	0
2	Incubation	30	60	10
3	Allofeeding	50	0	50
4	Feeding at nest	30	40	30
5	Territory defense	50	30	20
6	Vocalization	45	30	25
7	Feeding Fledging	40	40	20

Table 2 : Indian Birds exhibiting cooperative breeding

	Name	Source (Year)
1	Chestnutheaded Bee-eater, *Merops leschenaulti*	Papanna personal communication (1990)
2	Small green Bee-eater, *Merops Orientalis*	Sridhar & karanth (1993)
3	Jungle Babbler, *Turdoides striatus*	A.J. Gaston V.J. Zacharias ((1976) (1978)
4	Whiteheaded Babbler, *Turdoides affinis*	V.J. Zacharias and D.N. Mathew Karanth & Sridhar (unpublished) (1978) (1990)
5	Pied Kinfgisher, *Ceryle rudis*	H.U. Rayer Sridhar & Karanth (unpublished) (1989)

Table 3 : Influence of rainfall on nesting strategy of Bee-eaters

	Poor season		Good season	Total
	1989-90	1990-91	1991-92	
Rainfall (mm)	640	504	1260	
Helped	3	4	2	9
Unhelped	4	3	8	15
Total	7	7	10	24

Aggregation Pattern in Foraging Cattle Egret, *Bubulcus ibis*

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Introduction

The Cattle Egret, *Bubulcus ibis* is a resident, common bird of Bangalore with some local movements. The present investigation was to find out whether the birds had any aggregation pattern or intraspecific affinity while foraging.

Material and Methods

The study was conducted in an open land on the outskirts of Bangalore between February and June, 1989. A 2 km stretch of land along a village road was divided into 25 contiguous quadrats of 75 × 50 m which formed the sampling plan. In 10 outings, the number of Cattle Egrets in each quadrat was recorded. The sampling units were scaled up to five 375 × 50 m and three 625 × 50 m quadrats, and from these data, mean and variance-mean (V/M) ratio were calculated. The latter reflects aggregation, random and under-dispersed distributions for values greater than, equal to, and less than unity, respectively (Southwood, 1978). The relationship between mean density and aggregation were also worked out. These have been presented in Tables 1 and 2.

Results and Discussion

Table 1 shows that in majority of the cases, the egret showed aggregation while foraging, as reflected by the high V/M values. When the mean density was low as on 8.3.1989 and 29.4.1989, the distribution tended to a random pattern. On two scores the randomness shifts to an aggregation pattern: 1) when the mean density values are higher and 2) when the size of the sampling unit becomes larger, as seen for 29.4.1989 (Table 1). But when a single bird is seen (8.3.1989) in all the 2 km stretch of land, the distribution pattern remains the same, or becomes underdispersed with scaling up of sampling unit (Table 1).

Aggregation is, therefore, also dependent on sample size, a fact which needs to be considered while sampling the bird. In fact, as Table 2 shows, the correlation coefficient (g) has become from significant to highly significant, with scaling up. Aggregation at large sample sizes may not reflect flocking pattern so smaller sample sizes of 75 ö 50 m or even less are advocated.

The coefficient of affinity, expressed as a ratio of two or more birds/quadrat to birds/quadrat (even ones included) worked out to 0.67 on a scale of 0–1. Thus, Cattle Egrets, tend to have intraspecific affinity. This is helpful in exploiting food patch- wise, thus optimizing on resource utilization and, also vulnerability to predator attack is less in a group. Among all the sight records, only 33.33% times, Cattle Egret were found singly (Table 3).

The study clearly showed that Cattle Egrets are aggregated spatially and degree of aggregation increases with density and scaling-up of sample sizes. Thus aggregative behaviour reflects a non-random patch exploitation of food resource and probably helps avoid competition. Intraspecific affinity also contributes to aggregation and probably is a predator deterring strategy.

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Table 1 : Mean density and aggregation relative to sample size in Cattle Egret

Quadrat Size	75 × 50		375 × 50		625 × 50	
Date	Mean	V/M	Mean	V/M	Mean	V/M
20.02.89	0.32	4.89	1.60	3.31	2.67	2.38
21.02.89	0.44	1.72	2.20	3.96	3.67	4.45
08.03.89	0.04	1.00	0.20	1.00	0.67	0.50
13.03.89	0.16	1.92	0.80	4.00	1.33	4.00
04.04.89	0.32	4.88	1.60	4.25	2.67	3.50
15.04.89	0.12	3.00	0.60	3.00	1.00	3.00
29.04.89	0.08	1.00	0.40	2.00	0.67	1.99
04.05.89	0.00	0.00	0.00	0.00	0.00	0.00
22.05.89	0.16	2.44	0.80	1.33	1.33	1.75
06.06.89	0.00	1.00	0.00	0.00	0.00	0.00

Table 2 : Correlation between mean density and aggregation in different quadrat sizes, with intercept and slope

Quadrat size	Correlation coefficiant	a	b
75 x 50	0.690*	0.759	9.084
375 x 50	0.838**	0.892	1.795
625 x 50	0.793**	0.693	1.045

Table 3 : Percentage frequency of number of birds sighted within 75 × 50 m quadrat

Number of birds	Frequency (%)
1.	33.33
2.	33.33
3.	22.22
4.	0.00
5.	5.56
6.	5.56

Awakening, Roosting and Vocalisation Behaviour of the Southern Crow-pheasant *(Centropus sinensis) at Point Calimere, Tamil Nadu*

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Introduction

The Coucals or Crow-pheasants belong to the family Cuculidae. There are about 28 species in the Tropics (Fry *et al.*, 1988). In India little information is available on coucals (Hume, 1890; Baker, 1927; Whistler, 1963 and Ali & Ripley, 1983). The coucals are considered to be highly destructive to eggs and nestlings of birds. A detailed study was carried out on the ecology of the southern crow-pheasant *Centropus sinensis parroti* to find out their role in the ecosystem at Point Calimere, Tamil Nadu. The paper deals with awakening, roosting habits and vocalisation of the Southern Crow- pheasant.

Material and Methods

Intensive studies were carried out between July 1987 to September 1988 in two villages (Kodikkarai and Kodikkadu) situated adjacent to Point Calimere Wildlife Sanctuary (10° 18'N; 79° 51'E) and the observations on the intensity of calls were done in the Tropical dry evergreen forest of the sanctuary.

(a) Awakening

The first movement of the species was recorded in each month. To record this time, the site where the bird roosted at night was noted, and the next day the bird was watched before it woke up and the awakening time recorded.

(b) Roosting

The birds were followed in the evening till they retired for the night. The trees used, height at which they roost and the roosting time were recorded.

(c) Vocalisation

A record was kept on the different types of calls, their nature and the circumstances on which the calls were made were analysed.

Results and Discussion

Activity period

Awakening

The crow-pheasant is a 'late riser'. The mean awakening time varied from 0529 to 0610 hr during different months (Table 1).

The bird ws found to wake up 12 to 77 minutes prior to the sunrise which varied in accordance with different months. The day activity commences with preening and calling before foraging.

Roosting

After making contact calls, the crow-pheasants fly to the roosting spot. Usually before roosting, the pair perch and preen in the thick canopy of a tree or bush. Usually the pair roost side by side on the same tree or bush or one of the partner of a pair roosts on a nearby tree. The maximum distance observed between the roosting pair on different trees was 8 m. Some of the trees ad bushes frequently used for roosting are *Prosopis chilensis, Pandanus tectorius, Manilkara hexandra* and *Azadirachta indica* (Table 2). During June, when there is strong wind they prefer to roost in bushes like *Pandanus tectorius* or inside the thick foliage of trees. The roosting height varies from 1.5 to 9 m with a mean of 3.06 ± 1.16 (Table 3). Of the 110 instances of roosting recorded, the most preferred roosting height was between 1.5 and 4 m (87.3%).

The roosting time varied from 1801 to 1843 hr in different months (Table 1). During windy days, they reach the roost little earlier than usual. In the dry season it roostesd later than usual. But during the rainy season or on cloudy evenings it roosted earlier than the normal roosting time (Table 1).

Different birds show great variation in the time at which they roost in the evening and leave in the morning. Light intensities is probably, the one factor most universally influential in determining these times, but observations have implicated such other factors as circadian rhythms, length of day, season of year, stage of reproductive cycle, hunger, ambient temperature and type of habitat will also affect these timings (Welty, 1982).

Vocalisation

Thorpe (1964) pointed out that some of the advantages of songs and calls over visual displays, scents, and other forms of communication are the wide spectrum of vocal frequencies and intensities available; the modest energy expenditure required; sounds carry far, penetrates visual barriers, and are effective in the dark; and they vanish as quickly as they are uttered, making possible a quick succession of varied communications. During the study period, a total of eight distinct types of call were recorded.

Advertising call

Both sexes produce a quick repeated resonant "coop-coop-coop" in runs of up to a maximum of 34 "coops". The shorter sequences were produced at a rate of 2 or 3 coops per second. A continuous sequence of 34

coops takes between 14 to 17.5 sec. Both continuous and discontinuous sequence of "coop-coop" calls were noticed. A peak in the coop-coop continuous call was recorded in October before the initiation of breeding season and the intensity of both type of call was at the maximum during the breeding season.

Mobbing and alarm call

Ali and Ripley (1983) reported that the scold-note for the common Crow-pheasant *Centropus sinensis sinensis* when it mobs a lurking snake or owl etc., is an explosive "K'wisss". This call was also recorded in the Southern Crow-pheasants from its territory. Both sexes produce this call. It is an alarm call. On hearing this call, the young rush towards the parents for protection. The call has other uses also. It was observed that on hearing this call full grown nestlings usually hopped and glided down from the nesting tree. So the call has two functions: (i) alarm about danger and (ii) invitation to the ready-to-fledge-youngs to fly down from the nesting tree to the parents. The use is therefore determined by the circumstances.

Bubbling call

This is a rapidly repeated loud call as sounding "kok-kok-kok." It is given from a perch or while gliding to ground. It appears to be a summoning call from the female to the male. On one occasion, a male was noticed chasing the female after this call was produced by the female. Vernon (1971), observed a similar type of call in the Black Coucal *Centropus toulou toulou*. In Black Coucal Mackworth-Praed and Grant (1952) described this type of call as "bubbling call" and Fuggles-Couchman (1958) as "the bubbling water bottle" call. This probably is a contact call between the sexes during the breeding season.

Hissing call

When the nest is touched or disturbed the chicks produced a snake-like hissing sound. In case of older, chicks, the call sounds like a car engine with starting trouble!.

'Tch-truu' call

THe fledglings, juveniles and adults with young produced this call while foraging. It is probably a contact call.

'Chir-chir-chir' call

It is a soft, low pitched call given by young while begging for food.

'Quieehee' call

It is a loud harsh distress call given by young, observed when handled for ringing. It could be either be a plain distress call or to discourage predators.

'Ske-e-e-e-aw' call

This was recorded only on one occasion. A female glided from a tree to the ground. It then ran for a short distance with wings partly opened and vibrating and uttered this harsh cry. This call was also recorded for Common Crow-pheasant (Briggs, 1931).

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Table 1 : Mean awakening and roosting time (hr.) in relation to (mean) sunrise and sunset

Year	Month	Awakening		Sunrise*	Roosting		Sunset*
		n	time		n	time	
1987	Aug.	1	0540	0556	3	1830	1829
	Sep.	6	0543	0558	31	1816	1810
	Oct.	7	0543	0600	14	1807	1750
	Nov.	1	0530	0607	7	1807	1739
	Dec.	9	0607	0624	8	1815	1743
1988	Jan.	5	0602	0634	8	1801	1801
	Feb.	3	0610	0631	7	1838	1813
	Mar.	7	0555	0616	13	1837	1819
	Apr.	1	0539	0656	5	1803	1821
	May	3	0533	0643	5	1841	1827
	Jun.	3	0529	0643	8	1820	1836
	Jul.	1	0538	0550	3	1843	1838

*Source : 'The Hindu'

Table 2: Trees used by the Crow-pheasant for roosting

Tree species	Frequency	Percentage
Prosopis chinensis	65	59.1
Pandanus tectorius	19	17.3
Manilkara hexandra	12	10.9
Azadirachta indica	7	6.4
Thespesia populnea	2	1.8
Ixora pavetta	2	0.9
Ziziphus maurutiana	1	0.9
Ziziphus oenoplia	1	0.9
Borassus flabellifer	1	0.9

(n = 110)

Table 3: Height of roosting perches used by the crow-pheasant

Height (m)	Frequency	Percentage
1.5 – 4	96	87.3
4 – 6	13	11.8
6 – 9	1	0.9

(n = 110)

Time Budgets in Fruit-Eating Koel *Eudynamys scolopacea* and Barbet *Megalaima viridis*

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Introduction

Time budget, that is, the pattern of time allocation for maintenance and breeding activities is important in understanding the evolution of avian reproductive and foraging behaviour (Verbeek, 1972; Schemske, 1975) and the way natural selection operates to produce efficient individuals (Enoksson,1983; Bryant and Tatner, 1988). Birds that maintain feeding territories exclusive of the breeding season often utilize resources relatively stable in time and space (Schemske, 1975). The present study describes the time allocation patterns during fruit utilisation by two avian frugivores namely, the Koel (*Eudynamys scolopacea) and the Small Green Barbet (Megalaima viridis*).

Material and Methods

Study Area

Study was done in the Calicut University Campus in the Thenjipalam village of Malappuram district. The area is located about 25 km South of Kozhikode spread over an area of 500 acres. The vegetation is characteristic of scrub jungle and woodland habitats. The prominent plants include trees such as *Ficus* spp., *Macaranga peltata*, *Bridelia retusa*, etc. and thorny shrub like *Canthium* spp., *Zizyphus oenoplia*, *Lantana* spp., etc.

Data were collected from observations at a fruiting *Ficus benghalensis* tree between October, 1991 and April, 1992. The avian species under study, the Koel and the Small Green Barbet were the two major resident and specialised frugivores in this area.

Time budgets were constructed by focal animal sampling (Altmann, 1974). The focal individual has been monitored either for a period of 10 minutes or for the entire length of feeding bout when it lasted less than 10 minutes. The behavioural repertoire of a foraging species included: Foraging (icluding searching and feeding); resting or perching; flight or locomotion (other than for foraging and defense), agonistic; preening; courting; cleaning, etc. The time the bird was "out-of-sight" during a feeding visit was also measured.

Each behaviour was timed with digital and stop watches. The time spent in each activity was monitored and was expressed as percentage of the total time of observation. Temperature during observation varied between 20°C and 35°C. A pair of 7 x 30 Zenith binoculars was used for the observations.

Results and Discussion

The proportions of time allocated for different activities varied in *E. scolopacea* and *M. viridis* (Table 1). In the same species there were considerable variations in the time spent in different activities. Significantly greater proportions of time were allocated for foraging and resting than for other energy expensive activities ($P < 0.005$, one way ANOVA).

Foraging

The Koel spent slightly greater percentage of time for resting than foraging while the Small Green Barbet spent more time feeding than resting (Table 1). The Barbet allocated significantly greater percentage of time for foraging than Koel ($f = 10.94$ p 0.002). The latter maintained feeding territories which assured the bird a steady supply of food. The greater feeding time of barbet over koel was, probably due to increased accessary flight time and frenetic movements while foraging requiring increased feeding to maintain energy balance. Similar findings were made by Schemske (1975) in nectar feeding hummingbirds. According to him at non-limited food resources, the feeding time may be a function of time spent in energetically expensive activities.

Resting and Preening

Resting can be both a way of conserving energy (Magrath and Lill, 1983) and a buffer in the time budget, if the demand on another activity should increase (Enoksson, 1990). The Koel rested (x' 42.2%) and preened (x' 8.88%) for nearly half of the total time while the Small Green Barbet spent only one-third of the time budget for resting (x' 28.83%) and preening (x' 5.04%). An individual Koel perched on the same territorial branch for most part of the day. There was significant difference in the perching or resting time between the two species (Fig. 1, $P < 0.005$). The brief breaks that the small bird species had taken were, probably, for conserving energy for the next activity. The Koels, on the other hand, were more alert during interfeeding intervals.

Locomotion

The flight or locomotary activities included those exclusive of feeding, defense, courting,etc. The Koel undertook very little miscellaneous locomotion or flight and spent an average 0.05% of time budget while the Small Green Barbet had spent (x' 1.47%) a significantly greater percentage of time budget for such locomotary purposes ($f = 4.15$; $p < 0.005$).

Agonistic

Agonistic encounters were frequent between the two species. Intraspecific competitions were also seen. *M.*

viridis has been a severe competitor of *E. scolopacea* at diverse fruiting trees in the study area. The latter was dominating and always supplanted or scared off the Small Green Barbet whenever it encroached the Koel's feeding territory. An individual Koel successfully defended a territory of about 2 to 3 m^2 and was highly intolerant to all intruders, either conspecific or tetraspecific. The agonistic encounters were mostly intraspecific in the Small Green Barbet. It however, scared off other smaller species such as the Coppersmith *M.haemacephala*. The Koel had apportioned significantly greater proportion of time budget for agonistic activities than the Small Green Barbet ($P< 0.002$).

Courting

Courtship behaviours were observed in avian frugivores whilst foraging during the breeding season. But it was less frequent either in *E.scolopacea* or *M. viridis* during the present study and only a small fraction of time budget was allocated by each species for courting activities (Table 1). Courting chases between breeding pairs were observed amidst foraging. The male Koel was observed twice feeding the female with ripe figs during the breeding season.

Cleaning

Both *E. scolopacea* and *M. virdis* were "whole-feeding" species which often swallowed the fruits whole with or without brief manipulation by beak. Occasionally they were found cleaning the beaks by rubbing a branch or with toes. *M. viridis* allocated 5 to 25 seconds (1.06%) while the *E. scolopacea* allocated 5 to 15 seconds (0.73%) for cleaning activity in each feeding visit.

Out-of-sight

The Koel and the Small Green Barbet were at times lost in or masked by the folliage canopy during feeding bouts. They were, probably, at rest when they were out-of-sight, since foraging birds were easily detected. The barbet because of its cryptic green colouration was more difficult to be detected. It was out- of-sight for an average 7.32% of total time while the Koel was lost in view for slightly lesser time (4.76%).

The time of day and temperature influenced the daily activity patterns of birds (Estes *et al.*, 1986; Enoksson, 1990). Similar findings were made in the present study. The time spent feeding declined with increased temperature (Fig. 2a & 2b) as well as with progress in the day. Paulus (1988) found similar effects of temperature in the time budgets of nuthatches, *Sitta europea*. Intensive feeding observed in *M. viridis* at 25°C to 30°C while it was maximum in *E. scolopacea* between 20°C and 25°C. It declined with increasing temperature and minimum foraging activity was observed at about 33°C to 35°C in either species. However, there were no significant variations in the foraging times at different temperature since the fluctuations in temperature was relatively mild ($P 0.20$).

There were similar falls in the intensity of foraging in both the koel and the barbet as the day progressed from morning till mid- day. It increased further towards evening. Greater proportions of time were spent feeding in morning and evening than in mid-day. At high temperature it might have been energetically advantageous to reduce feeding while low temperature increased the energy requirements for maintenance (Bryant and Tatner,1988; Paulus,1988). Caraco (1979) found that the Yellow-eyed Junco, *Junco phaeotus* spent more time foraging at lower environmental temperatures.

As foraging time decreased, time spent resting and preening increased (Paulus, 1988). In the present study, there was no marked change in time resting in *E. scolopacea* with increase in temperature (Fig. 2b). However, the preening time has increased a little. Both the resting and preening times were increased considerably in *M. virdis* (Fig. 2a).

Our data on time budgets supported the hypothesis that the territory maintaining bird species spent less time foraging than widely foraging species. The present study was helpful in understanding the energetics of foraging in avian frugivores and its fluctuations with change in environment variables. It also revealed the social status of the foraging species with socially dominant species spending more time in defense and aggresive encounters. More extensive study on time budgets of individuals might be helpful to determine the population status of bird species in the habitat.

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TABLE 1: Percent time spent in activities by (I) *Edudynamys scolopacea* and (II) *Megalaima virdis* during foraging at *Ficus benghalensis*

	Resting	Foraging	Flight	Chasing	Oos	Preening	Courting	Cleaning	N
I	42.26	36.33	0.05	6.86	4.76	8.88	0.13	0.73	77
	(20.56)	21.72)	(0.20)	(9.55)	(9.55)	(13.84)	(0.36)	(0.78)	
II	28.86	54.66	1.47	1.45	7.32	5.04	0.07	1.06	50
	(17.35)	(17.57)	(1.67)	(1.09)	(10.83)	(11.38)	(0.34)	(0.96)	

(Data in parenthesis is standard deviation; N - number of samples) * Oos = Out of sight.

Fig. 1

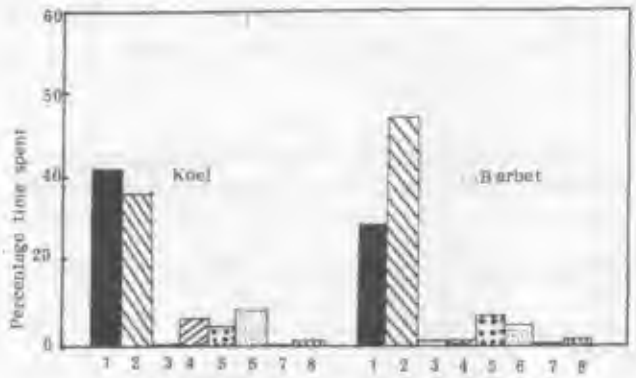

Fig. 1. Percent time spent in activities by (A) Koel (B) Small Green Barbet. 1 - resting; 2 - foraging; 3 - locomotion; 4 - agonistic; 5 - out-of-sight; 6 - preening; 7 - courting; 8 - cleaning.

Fig. 2A

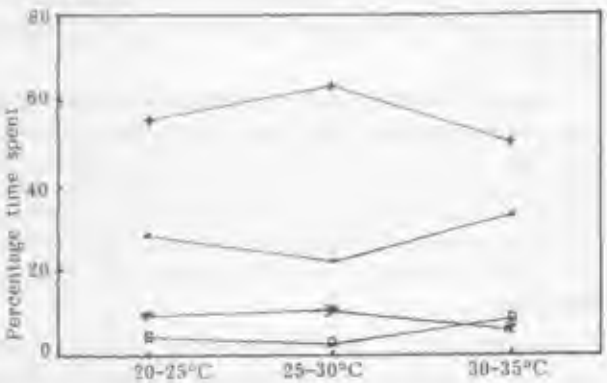

Fig. 2B

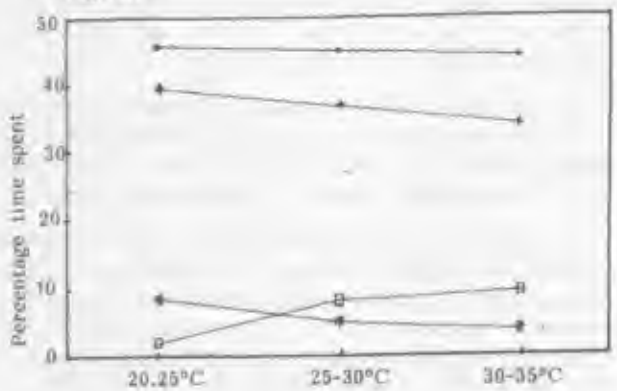

Fig. 2A & 2B. Effect of Temperature on time spent in major activities in (A) Small Green Barbet. (B) Koel
. - resting; + - foraging; - preening; * - out-of-sight

Benefit of Being Attractive : Fruit Colour and Animal Dispersal

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The evolution of fruit colour is a topic in evolutionary ecology that has been known to naturalists for at least two hundred years (Snow and Snow, 1988). Fleshy fruits characterize the majority of woody angiosperms (Wilson *et al.*, 1989).

In animal dispersed plants species, colour is one of the many factors determining fruit choice in the wild (Wheelwright and Janson, 1985). Fruit colours are a form of long distance advertisement to fruit foragers (Ridley, 1930). Fruit colors can be classified into light and bright colours. The present investigation assess the possible potential adaptation of these dicotomous colour categories for dispersal.

Light colour fruits are green, white and brown and bright ones are red, orange, black and yellow. We hypothesize that bright colours are costly to produce and maintain than light coloured fruits. By having more number of seeds per fruit in bright coloured ones, compared to its light coloured counterparts, the bright coloured costly fruits will be able to attract more dispersers and hence have better dispersal advantage.

We have tested this prediction by collecting data regarding fruit colour and seed number per fruit for animal dispersed species both from literature and from personal observations. Here animal dispersed species included dispersal by both birds and mammals. Out of 92 animal dispersed species studied majority of the species contained many seeds in them (Fig.1).

We expected higher frequency of bright coloured fruits among these species. From Fig.2 it is evident that 73% of them produce bright coloured fruits. These colour morphs are further classified into seed number classes (Table 1).

Though there are significantly more number of species having many seeds in bright colour category; same pattern was true with light colour category also. We expected more number of light coloured fruits to have few seeds in them. On further classification of these seed number classes into type of fruits they produce relatively, high frequency of many seeded fruits under light category produce multiple/aggregate fruits (Table 2). Here whole fruit is not dispersaed as such, only part of the fruit is dispersed at a time. In aggregate/multiple fruits we did not find any significant difference between few and many seeded species under light colour category. The test of prediction is incomplete owing to the lack of good sample size for light coloured fruit.

It is unlikely that evolution of fruit colour has a single explanation and a variety of possibilities must be prevalent. Nevertheless, one of the important priorities lies in attractive dispersal agents. Sixty seventy percent of tropical fruits are known to be dispersed by animals. Out of this birds comprise the maximum percentage. Hence bird-plant coevolution is one of the central themes in understanding the ecology of seed dispersal in tropical forest.

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Table 1: Distribution of animal dispersed plant species into classes of colour types and seed number.

	Seed		
Colour	Few	Many	Total
Light	8	13	21
	(7)	(14)	
Bright	23	52	75
	(24)	(51)	
Total	31	65	

Note : Figures in parentheses represent expected frequencies.

Table 2: Distribution of seed number classes into type of fruits

Colou seed classification	Few Nut	Aggregate /multiple	Seed	Many nut	Aggregate/ multiple
Light coloured 8	-	-	10	1	2
Bright coloured22	1	-	46	2	4

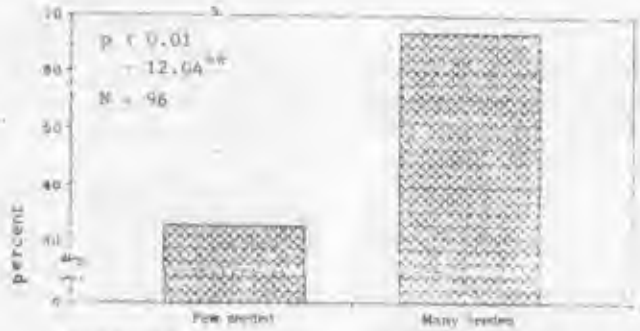

Fig 1. Distribution of animal dispersed plant species into few (1-3) and many (more than 3) seeded classes.

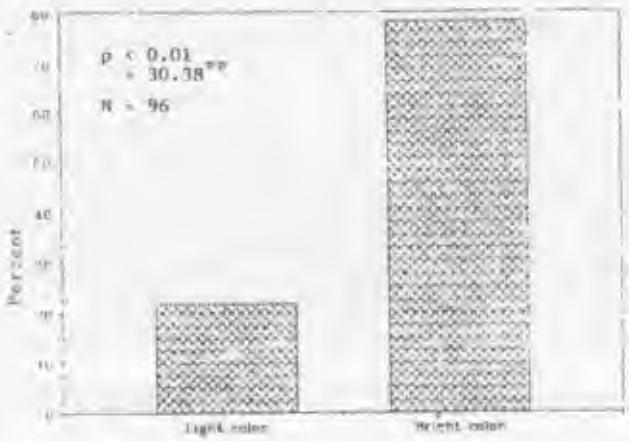

Fig 2. Distribution of animal dispersed plant species into bright and light colour categories.

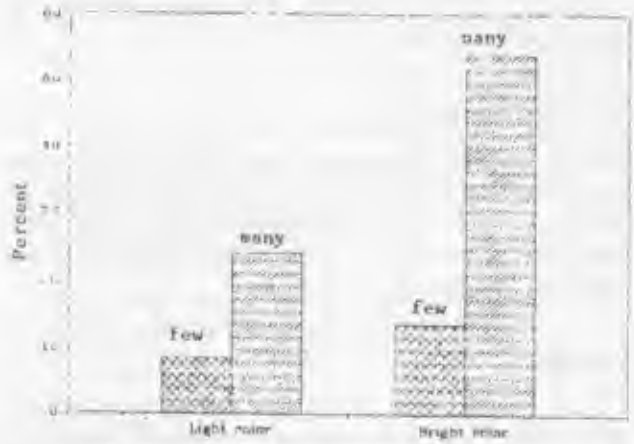

Fig 3. Frequency distribution of seed number of animal dispersed plant species into light and bright colour categories.

Breeding Behaviour Sequential Polyandry and Population Decline in *Rostratula benghalensis*

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Introduction

Two species of painted snipes occur in the world; the Old World Painted Snipe, *Rostratula benghalensis* and the South American Painted Snipe, *Nycticryphes semicollaris*. The former which is widely distributed, occurs in Tiruchirapalli, Tamil Nadu, has been under observation since December 1981. *R.benghalensis* is said to be polyandrous. The female, being physically larger with more brilliant plumage than the male, is the dominant partner in courtship (Baker, 1934; Austin, 1962; Sick, 1968; Ali and Ripley, 1987) and has the most elaborate vocalization (Thorpe, 1961). Threat display has been documented (D'Ombrain, 1944; Austin, 1962; Lowe, 1963 & 1970; Muller, 1974 & 1975). Evidence has already been established for the presence of surplus competing male in the breeding territory of mated pairs (Wesley, 1986). The chick and its attachment to the male has been reported (Wesley, 1991). No information however is on record on the elaborate courtship display, sex-ratio, territoriality, nest-site selection, nest building, egg laying and incubation pattern and period. An attempt is made in this paper to present the data from December 1981.

Material and Methods

The study area consisted of two pieces of fallow land herein referred to as Sector I & II in Tiruchirapally, as shown in Fig 1. Outside the sector I was a house that served as the observation station (OS). Sector II was less disturbed than sector I.

Vegetation

The ground cover of the two sectors was of three species of *Cyperus stolonifera, C.bulbosus, C.difformis* interspersed with water puddles with *Morselia* sp growing. The other plants were *Prosopis juliflora*, mostly in sector-I, *Acanthus* sp, *Oldenlandia* sp, *Eclipta alba, Moneira cunefolia, Lippia nodiflora, Croton sparsiflorus, Paspalum conjugatum, Eriochloa procera* and *Echinochloa colonum*. The Prosopis plants varied in heights from 30 to 100 cm and was distributed with Cyperus grasses-an ideal breeding ground for the Painted Snipes. *Typha angustata* formed a dense cover in Sector II.

The Observations were made from early morning before sunrise to late evening after sunset. Constant vigil was kept to record the number of females that were in the Cyperus-infested fields accompanied by their male partners and the rival males, if any. The first courtship call during a month was taken as the starting point of the breeding activities of the bird in the area.

When there were no gaps in the courtship call between any consecutive months, judged from the length of the period of their presence, it was allotted to the next month's data (Tables 1 and 2). When felt necessary the birds were flushed out of the grass.

All the birds seen were assessed for the sex-ratio and population dispersal. Only fourteen pairs were followed closely for recording breeding activities. Only eleven of them established territories and bred (Table 3). These birds were designated serially in Roman numerals as and when arrived, and the territories when established were given the corresponding numbers, leaving out the unsuccessful ones. Fertilization displays, of copulations, coitus and egg-laying time and time taken to lay an egg. When possible as in the case of pair VIII, observation was kept up continuously during the day for the entire period of incubation and for the nights on the rhythm of incubation (Tables 5).

A pair of binoculars 8 x 50 mm (field 6.5°) was used. For recording the time, a pen-electronic timer was employed. The observations were noted down in detail on loose sheets of paper which were later filed for reference and retrieval.

The probability of the observed sex-ratio was analysed statistically (Graeme Caughley, 1978). Besides x^2 testing, 95% confidence limits were calculated for the data on the male-female abundance for each year and for the consolidated data of eight years of observation, using the formula: Pf ± 2 SE, where Pf is the proportion of females and SE the standard error of Pf calculated from $SE = \sqrt{\frac{pf(1-Pf)}{n}}$. It was also calculated for the ratio of males per hundred females as: $\frac{M \times 100}{F} \pm 200\sqrt{\frac{Mn}{F^3}}$ where M is male, F, female; and n, the sum of both.

Results and Discussion

Breeding season and bird abundance

Monthly and year-wise distribution of abundance is presented in Tables 1, 2 and Fig 2 for most of the period between 1981 and 1993. Since 1989 the birds declined in number. The occurrences were sporadic and no breeding activity was sighted (Table 1a).

Sex-ratio

More than one male was observed on some occasions to follow a female to the breeding territory. The maximum number by which the males were in excess was five, in

1984. In 1988 no surplus males was present with the paired birds (Tables 1,2 and Fig 3).

Pre-copulatory display

The mutually stimulating displays occupied 99.6% of the total display. In all cases observed in full, the pairs lay either facing each other or back to back 1-5 m apart in the territory and performed several movements of the body that formed a ritualized series as follows :

The female preens the breast and the shoulder for a considerable time, and then takes a few steps lateral to the male's lying position. If the male is not in view the female opens the wings upwards, or, if the male is unmoved and remains preening, the female preens the breast and the shoulder, quivers the wing quills and preens under them. The female may take a few steps in the same direction of the male, or remain at the same spot and dip the forepart so as to expose the white undertail with the spasmodic cloacal lips. At this, the male moves out to another location to stand and preen, or to stride forward. Meanwhile the female snaps open the wings once or more, and continues preening of the breast and the shoulder. This ritual is interrupted at any point, by the female, with a bath, often reciprocated by the male. Coming out of the water they continue the ritual.

The opening and closing of the wings was the most conspicuous of the element in the display. Suddenly the female quivers the wings and wags the tail. At this the male utters and inaudible signal, the throat rising and falling, and, then leads the female along a familiar, relatively dry, grass-free copulation path. However, the female overtakes the male and leads, while both the pair now moves the hind quarters vigorously up and down. The female halts at a specific 'copulation spot' on the path and stands still in a slightly couched posture. This is invariably the ritual sequence culminatig in copulation.

Copulation display

In the copulation display, the male climbed on to the female's rump from behind stood full erect with rapid movement during which coitus was accomplished. The male did not flap the wings to balance on top of the female nor did he hold her with the bill. This entire act took 5.93 seconds on an average and 0.02% of the total display. The time, frequency and abundance of the twenty nine copulations of successful and unsuccessful pairs are summarised in Table 4. Copulations occured before and after laying the eggs and after the completion of the clutch. The maximum number of coitus recorded for a pair per day was three for pair XI, the intervals between the first and the second, and between the second and the third were 10.5 and 505 minutes, respectively on 16 January 1984; two for pair II, III and VIII, occurring at a time interval ranging between 5 and 2 h 30 minutes.

Post Copulatory display

On the dismounting of the male, both the pair froze at once in an 'ecstatic' posture, head lowered, bill directed down and backward, the dorsum sloping forward. The average time taken in the 'trance' was 4.96 sec and about 0.02% of the total display. This ends abruptly and both birds move either in the same or different directions simulating feeding even if the area was without water. Thereafter, they invariably either forage or rest, standing on one leg, the bill tucked into the scapulars. If the nest has already been established one of them occupied it to improve upon it, lay an egg, or incubate. If the copulation was toward the close of the day the pair demonstrates some of the ritual sequences.

Nest-site selection

The nest-site selection was a part of the courtship behaviour of the Painted Snipe. On arrival to an area each pair checked and inspected the vegetation and ground in the territory. The nestworthiness of the site was first checked by the female bird followed by the males.

Nest building

The nesting site decided upon, the female bird began preparing the bed which was to receive the nesting material. Sitting within the encircling grass-stand she pressed down the soft, moist muddy ground with the breast, the feet anchored behind the body turning around at the same time to form a depression. This done, she pulled up while sitting within the 'nest', the decaying grass blades and stalks from under the water around and pressed them into the soil. More material were collected from under the water within radius of a meter from the entrance, the bird wadding through it pulling up and throwing them with a jerk of the head over the shoulder, backwards towards the nest site as she went along.

Later these material with the clinging mud were pulled into the nest, the bird sitting within. Floating things and dry material were never observed being gathered for the nest bed.

Around the nest were the stalk and blades of the peripheral standing grass which the female pulled in from all directions. Much time was spent before and during laying in conditioning the blades of grass by individually holding and manipulating them from base upwards with the mandibles to make them bend and stay over the nest in a cone. During incubation, the male took over this maintenance activity.

The time taken for the completion of the nest showed variations, from four to seven days after arrival in to the territory (Table 3).

Positions of the nest

In Sector I enclosures formed by prosopis bushes provided suitable nesting places and afforded a certain amount of protection from grazers. One nest in Sector II

was found at the base of a small herb of *Oldenlandia* sp with cyperus growing around it. The nest was quite open as the grass cover was inadequate. Another nest was placed under a low horizontal twig of prosopis but within a stand of Cyperus grass; another nest was on a lump of mud between closely transplanted paddies with a few cyperus growing along with them.

Breeding Territories

In the study area of the fourteen pairs only eleven established territories (Table 3). Deserted territories were observed occupied again by the respective pairs, but other pairs altered their territories to occupy the deserted areas.

Nest Spacing

In sector I of the breeding area, five pairs of Painted Snipes established nests and clutches; pair VI was unsuccessful. The least distance between two nests was 15.5 m and the greatest 39.6 m.

In Sector II only two nests, 30.9 m apart, were active at the same time in February 1982. Others were lone nests isolated in time occurring in different months.

Egg laying

The time interval between the arrival of a pair and the initiation of the clutch varied. It was 8 days for pair I, 9 for pair II, 4 for pair V and X and 3 for pair VIII. For the other pairs either the arrival or the initiation of the clutch could not be observed.

About the time of deposition of the eggs, two of pair II and VIII, one of pair V, and all of pair X were laid during the forenoon while two of pair VIII were deposited in the evening. Considerable variation was observed in the time taken to lay an egg since the female entered the nest. The shortest duration was 3 mt for pair X and the longest 2h 05 mt for pair V for the first egg, the average time inside the nest being 29.5 mt. The interval between the layings of any two consecutive eggs varied between 15h 45 mt and 24h 39 mt with an average of 22h 33mt.

Usually the male accompanied the female to the nest and, remained about 1 to 1.5 m away from the nest, communicating by preening and gulping movements of the throat. In case of disturbances from cattle or humans, the female left the vicinity till the area was clear.

After egg laying the male adjusted the egg(s) and the nest-bed, if necessary, by collecting more material. The female remained close by or moved away depending on the situation but never left the territory. Interestingly, with the completion of the clutch the female partedcompany indicated by characteristic 'farewell wave' of one of the wings.

Mostly, the female left the male and the territory on the completion of the clutch. Pair V, however, remained with the male even two days after the third and last egg of the clutch.

Incubation and Incubation Period

The data on clutch initiation (Table 5), completion and date of hatching were also recorded.

Hatching Success

Of the 38 eggs in 11 nests only 5 eggs in two clutches hatched, resulting in 13.15% hatching success. The fate of the only egg of clutch I was not known. Clutch II was deserted owing to pedestrians crossing the field. Clutch III, IV and V were trampled by cattle. Clutch VI, VII and X were submerged in water. Although no precise data were available, the female of the Painted Snipe is believed to lay several successive clutches for as many males. That the species is polyandrous is based on the fact of the reversed sexual dimorphism, the female's dominance in courtship display, and the declining consorting ratio with the laying of every egg in a clutch (Komeda, 1993; Ali and Ripley, 1987). Another aspect is that of the biased sex ratio in favour of the male. The male to female ratio for the Painted Snipe in Tiruchirapalli was 1.09:1 and the relative percentage for all the years of observation, from 1981 - 1988, were 52.1 and 47.9, respectively. (Tables 1 and 2). As per the data on hand the female Painted Snipe does not liberally lay eggs in a number of nests, as stated by Skutch (1957). Male-usurping by unoccupied females may be a factor that mated females may have to guard themselves against in the species. There was only a slight preponderance of males and x^2 testing was not significant, $P = 0.40$ to 1. Other statistical analyses, however, suggested that the male or female preponderance with marked disparity is to be expected. With more of one sex than the other, especially where female biased, there must be periodic erratic population structure affecting breeding opportunities.

Unlike the polyandrous Sandpiper whose females arrive at the breeding ground earlier than the males (Oring & Lank, 1982) the two sexes in the Painted Snipe do so together. The difference between the two must lie in the nature of the territories: one has mating and breeding performed in the same ground yearly visited; the other must have separate mating and breeding territories. It is likely that in the latter the mated birds scatter themselves in search of suitable breeding grounds leaving behind the unsuccessful rival males some of whom, not accepting defeat, follow the females with determination to win them over that is frustrated again in the breeding territory (Wesley, 1986). With the laying of each egg the consorting time is reduced and the bond between the two sexes weakens so that the female becomes free to seek another male (Komeda, 1983). Oring and Maxson (1978) have observed that "as long as the primary males are capable of excluding additional males simultaneous polyandry is impossible". The instance of surplus male-intruder into another territory being ejected out is a point in support of sequential polyandry (Wesley, 1986).

Major portion of the time in fertilization display was taken up by precopulatory display. Nest- building is not the responsibility of the male Painted Snipe. Both the partners select the neat sites, the female inspecting it first, followed

by the male. The females observed in Tiruchirapalli retained the task of making the nest , in contrast to that reported by Baker (1934) and Gooders (1975). Although an egg was laid each day the interval between any two consecutive eggs was not exactly 24 hours, but ranged between 15 h 45 mt and 24 h 39 mt, the average being 22 h 33 mt. Shorter interval between the first and the second egg of pair V is clearly an indication of close ovulation, and the presence of two eggs in the oviduct at the same time though at different points (Table 7). The time of deposition of the third and last egg was not known. The triggering of ovulation is a complex physiological process involving visual and tactile stimuli inducing hormonal action. Craig (1911) has observed that female pigeons and doves ovulated and reached oviposition without male's contact in mating. There is no definite proof that in the Painted Snipe either or both the stimuli are employed. Copulation in the Painted Snipe was observed to occur through the egg-laying period, as coitus may serve as a stimulant for egg laying.

On the incubation period in the Painted Snipe, Baker (1934) states, "I do not know how long it takes". Schmidt (1961) reports that it is 19 days for the South African population. It agrees with present observation of 18 days (Table 5). All the eggs of a clutch hatched on the same day despite the differences in the laying time (Table 5). Further, the data corroborated the observations of Baker (1934) and Ali (1979) that the breeding season is "more or less through out the year", or "practically throughout the year" (Tables 1 and 2; Fig.2). Sporadic and rare occurrence of the birds after 1988 must be related to the enormous changes that have happened since: copious growths of *Typhangustata* and *Eichhornia* sp, and the fallow lands being alternately inundated and dry, cattle grazing and development of human settlements in planned colonies. These have resulted in population decline, and if the trend continues, Painted Snipes may become extinct in the suburbs of Tiruchirapalli.

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Table 1 Eight year count of Painted snipes in breeding territory in Tiruchirapalli

month	jan	feb	mar	apr	may	june	july	aug	sep	oct	nov	dec	total
	f m	f m	f m	f m	f m	f m	f m	f m	f m	f m	f m	f m	f m
1981												9 10	9 10
1982	1 2	3 4	3 3	1 1					7 9	3 3	2 2	4 4	24 28
1983			3 4	4 5		6 6		2 2	2 2		1 1		1 8 20
1984	3 3	0 8	5 5	2 2			6 5	8 8	4 4	6 7	8 9	4 4	5 2 55
1985	4 4	6 7	10 10	6 6	2 2	2 2		3 3	5 5	8 10	3 3	1 1	50 53
1986			4 5		1 1	1 1	2 2	4 5	3 3	3 3	8 10	3 3	29 33
1987	2 2	4 5	3 3	4 4	1 1		4 4	3 3	2 2	2 2			28 30
1988	2 2	3 3		1 1	4 4	3 3							13 13
Total	11 12	22 27	28 30	18 19	8 8	12 12	12 11	20 21	26 29	22 25	22 25	21 22	223 242

Table 1A Occurance of Painted snipes since 1989

Year	Date	Month	Time of call
1989	31	July	04.10
1990	09	February	22.05
	29	June	05.00
	29	October	05.45
1991	09	February	18.50
	18	February	05.45
	23	February	05.30
	03	March	21.30
	29	March	22.00
			22.30
	03	April	21.20
			21.50
	13	April	21.55
1992	30	January	03.40
1993	24	January	06.10
	01	September	18.40
			21.50
			22.00
	03	September	22.10

Fig 1. The Breeding area of the Painted Snipe in Tiruchirapalli.

Table 2 Percent occurence of Male/female Painted snipe for eight years

Year	1981	1982	1983	1984	1985	1986	1987	1988	1981-88
									Total
No	10	28	20	55	53	33	30	13	242
Percent	52.6	53.8	52.6	51.4	51.4	51.4	51.7	50	52.1
No	9	24	18	52	50	29	28	13	223
Percent	47.4	46.2	47.4	48.6	48.6	48.6	48.3	50	47.9

Table 3 Arrival of birds, initiation of clutch and clutch size for eleven pairs of *R. bengalensis*

Bird pair / sl.no	Day of arrival	Days of laying the egg the eggs (1 -4) 1	2	3	4	Remarks
I	03-12-1981	10th	-	-	-	The egg was lost; nest desersted
II	14-12-1981	22nd	23rd	24th	25th	Clutch size 4 eggs
III	15-12-1981	?	?	?	22nd	Clutch of 4 eggs
IV	24-12-1981	?	?	?	?	Clutch of 4 eggs noticed - 2nd Jan 82
V	29-12-1981	1-1-82	2nd	3rd	-	abandonded on 6th Jan 82
VI	01-02-1982	?	?	8th	9th	3eggs on noticed on 8th, 4th on 9th
VII	02-02-1982	?	?	?	-	Clutch of 3eggs noticed on 13th
VIII	05-04-1982	7th	8th	9th	10th	Clutch of 4 eggs
IX	16-09-1982	?	?	?	-	Clutch of 3 eggs noticed on 8-10-82
X	06-11-1982	9th	10th	11th	12th	Clutch of 4 eggs
XI	?-01 1984	14th	15th	16th	17th	The arrival of the birds not known, spotted nest on 12th Jan

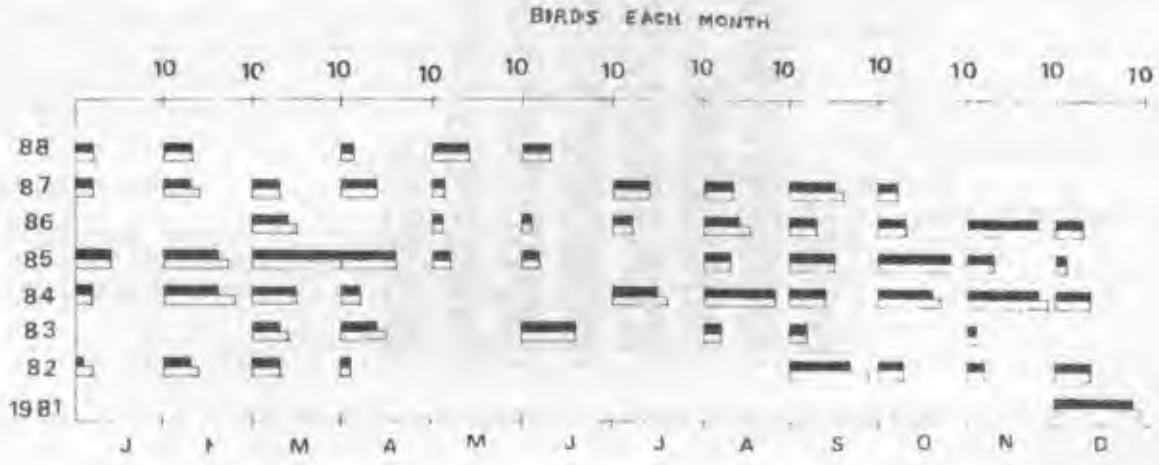

Fig 2 Month and year -wise occurence of the Painted Snipes

Table 4 : Time of day, relative abundance and percent occurence of copulation in the Painted Snipe						
Time of the day	06:00- 08 :00	08:00-10 :00	10:00- 12 :00	12:00- 14 :00	14:00 -16 :00	16:00- 18 :00
Number of Coitus	5	6	2	1	2	13
%	17.2	20.7	6.9	3.5	6.9	44.8

Table 5 : Incubation period				
Bird pair No.	Clutch		Hatched on	Incubation period (Days)
	Initiation	Completion		
VIII	07-04-1982	10-04-1982	28-04-1982	18
XI	14-01-1984	17-01-1984	04-02-1984	18

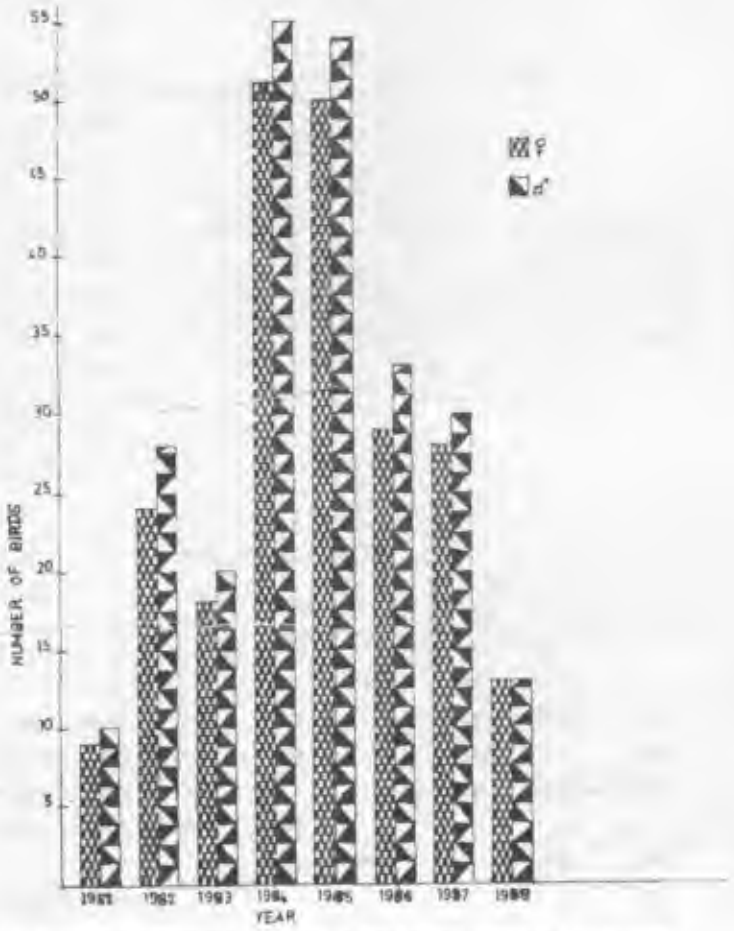

Fig 3. Relative abundance of the sexes in the Painted Snipes in Tiruchirapalli.

A Report on the Susceptibility of Chicks to Mammalian Trypanosome

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Introduction

Trypanosoma evansi is a pathogenic parasite in many mammals causing surra disease. The infection is of 2 types: 1) Acute and 2) Chronic. In birds, natural infection of *T. evansi* has not been reported so far, inspite of the abundance of the pathogen and the arthropod vector.

Manuel *et al.* (1985) in their review mentioned that trypanosomes inoculated into several birds including chicken were not detected on blood examination and the blood was not infective to the laboratory animals. Alwar (1962) reported that he could successfully maintain *T. evansi* in freshly hatched three day old chicks for 69 days. He stated that the chicks did not show any clinical manifestations. The present report is the experimental survival of *T. evansi* in one day old chicks and the changes in the serum LDH due to infection.

Material and Methods

T. evansi was collected from the buffaloes of the rural areas of the Khammam District and were maintained in the laboratory Albino rats. The trypanosomes from the Albino rats were isolated from the blood by centrifugation and were suspended in phosphate buffer solution. When the trypanosomes were 3.5 x 10^4/ml/ of concentration, 0.5ml was inoculated into the chicks intraperitoneally. The chicks of one-day old, one-week and 4-week old were taken for experimental study.

Blood smears were made daily from the infected chick, fixed in methyl alcohol and stained with Giemsas stain. The blood from the infected chicks was collected and serum was separated.

For the chick serum LDH isozymes, the gels were prepared with acrylamide gels according to Dtiz and Librano and the gels were run for 90 minutes. The gels were incubated for 1 hour in a mixture containing sodium lactate, NAD, NACL, $MgCl_2$, phosphate buffer and Nitrozolin blue. They were then photographed.

Results and Discussion

The infection was observed after six days only in the one-day old chicks but did not appear in the one-week or 4-week old chicks. The degree of parasitemia was 1 trypfield in the low power (Fig. 1). The same degree of parasitemia persisted for 5 days and later disappeared. On dissection and examination, trypanosoma was not found in any of the organs. In older chicks inspite of giving larger doses of trypanosomes twice, the infection did not appear. The infected birds did not show any pathological symptoms. The infected serum LDH isozyme pattern showed 3 bands only and LDH-2 was missing while LDH-3 was not distinguishable from LDH-4. In case of normal chick, 4 bands were distinguishable (Fig. 2). The Rf values of bands in gel (a) from bottom to top were 7, 3, 2 and 0.5 cm. The 7 cm migrated band is fast migrating and 0.5 cm is slow migrating. Similarly in gel (b) the Rf values were 3, 1 and 0.5. The 3 cm migrated band is fast-migrating and 0.5 cm slow-migrating.

The results obtained indicated that the chicks can tolerate the infection at a very young age. These findings agree with observations of Manuel *et al.* on ducklings.

In our study, the parasites could be seen in the wet films for five days similar to the study of Alwar (1962). Even in our study one-week and 4-week old chicks did not show infection.

In one-day old chicks the bursa would not develop, hence there will not be a production of immunoglobulins to react with the parasite. From this we can presume that due to the deficiency of specific Ig production, the parasite could survive where as in 1 week old chicks, bursa develops. So, it acquires immunity and can react with the parasite.

Infection brings about numerous changes and LDH isozyme pattern is one of the markers for susceptibility. The change in the serum LDH pattern could be due to a change at the level of gene transcription.

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Fig. 1) Photograph showing the *Trypanosome evansi* in the peripheral blood of the chick.

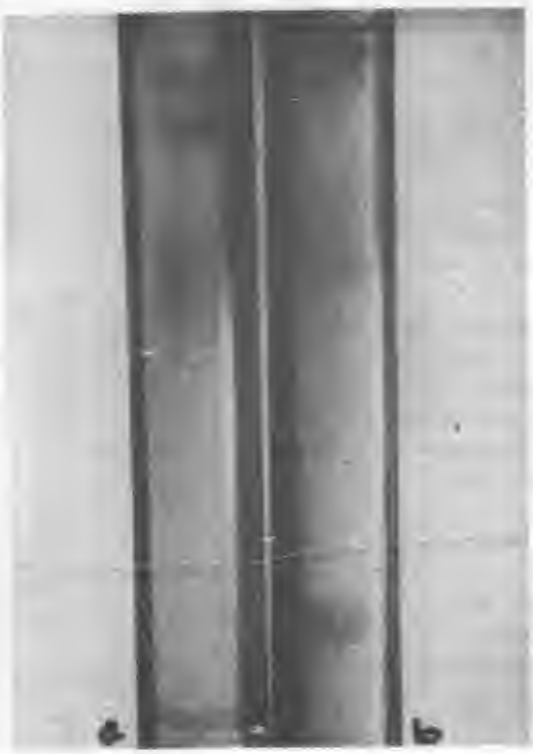

Fig. 2) Photograph showing the LDH band pattern
(a) Normal chick serum (b) Infected chick serum

Sexual Size Dimorphism in *Columba livia* and Sex Determination by Discriminant Analysis

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We recorded data on external characters of Blue Rock Pigeons, Columba livia, to determine the sexual size dimorphism and to develop a reliable sexing technique for this monomorphic species. In all 96 adult pigeons were collected and 10 characters viz. body weight, premaxilla, culmen, bill length, bill width, wing, tarsus, tail and middle toe were measured. Principal component analysis revealed a highly significant size dimorphism($F=18.82$, d.f.=1, 91, P). Males were significantly larger than females in all characters except premaxilla lengths which did not differ significantly (univariate comparisons using t-tests). Monthly variations were significant in bill length, bill width and tarsus length but they did not significantly interact with sexual size dimorphism. Discriminant analysis revealed that a combination of bill depth, tarsus length and middle toe length was the best for distinguishing between males and females (Wilk's Lambda=0.499, Chi-square=64.38, d.f.=3, P). The classification function using these three characters correctly classified 88.5% of adults. This function had an accuracy of 96.2% in identifying the sex of an independent sample of 26 pigeons. The data of both samples were pooled to derive a new classification function for use in the field.

Microscopic Identification of Feathers with the Scanning Electron Microscope

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The identification of bird species has been attempted earlier by analysing the structure of barbules with an optical microscope. It is comparatively difficult and can be confusing at times. By using a Scanning Electron Microscope, more details can be observed, especially the three dimensional projections on the barbules which aid in better identification.

In a small study, the structure of feathers from a few species was analysed. There were similarities within related species. The barbule structure also had inherent differences within the same species. Powder keratin has been observed in the Blue Rock Pigeon. Birds which exhibit soaring flight showed similarities with barbule projections being absent or degenerate. It is postulated that the barbule structure is dependent on the nature of flight of the avian species.

Atmospheric Temperature and the Incubation Pattern in the Ashy Wren-Warbler *Prinia socialis*

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A cursory survey of the literature shows that several passerine species of subtropical and temperate regions show a very high rate of attentiveness to their eggs, from 64.5%(Hedge Sparrow) to 84%(Marsh Tit) (Wing, 1956). This may be an adaptation to overcome the considerably cold climate to which the eggs are exposed. The phenomenon suggests a relationship between the atmospheric temperature and the attentiveness of the parent bird/s to their eggs. The present paper describes the findings on such a phenomenon in a tropical bird, Prinia socialis (Ord. Passeriformes; Fam. Muscicapidae) of Dharwad City (15 28' N, 79 01' E) (Karnataka state).

In one clutch, three eggs were laid from 18th to 20th June 1993. Incubation commenced from 21st June. The incubating bird/s did not develop any brood patch. From the first day of incubation till the hatching of the eggs the maximum and minimum atmospheric temperatures and the body temperature of the incubating bird were recorded. Further, periods of attentiveness in minutes were also recorded each day from 11.00AM to 7.30P.M. and from 7.00AM to 7.30P.M. on some days at random.

Our observations showed that from 18th to 28th June there was a gradual rise in the atmospheric temperature from 27.7°C to 33.2°C. It again dropped to 27.8°C and 27.3°C on 1st and 2nd July the last two days before hatching. The body temperature of the incubating bird was fluctuating between 40.2°C and 41.5°C. The period of attentiveness was 30% on the first day of incubation. It rose to 50% on the 5th day and remained at that level upto the 10th day. However, on the 11th and 12th days, it further shot upto 69% (Fig.1).

The data indicated that, (i) owing to the lack of the brood patch the parent bird cannot pass on its entire body heat to the eggs; simultaneously some heat is also lost to the surroundings because of loose construction of the nest; (ii) the optimum temperature requirement in the initial phase of development of the eggs appears to be close to 30°C and hence the period of the attentiveness by the parent bird is also minimum; (iii) but during mid- and terminal phases it might be considerably high; as a consequence the period of attentiveness correspondingly rises, (iv) finally, the steep rise in the period of attentiveness on the last two days of incubation is a measure to counter the effect of the sudden drop in the atmospheric temperature.

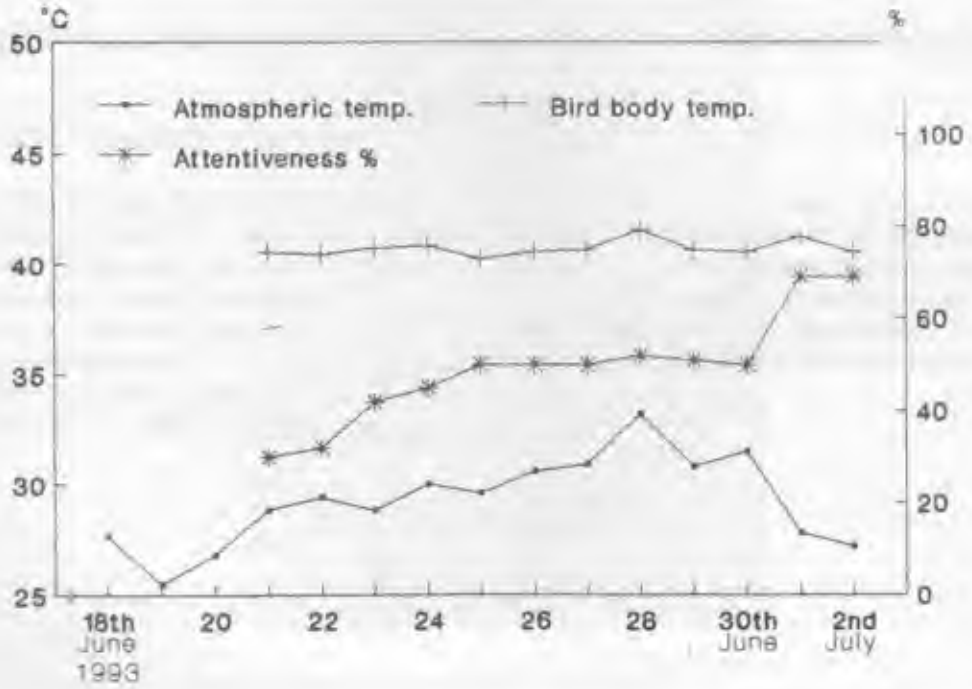

Fig.1. Showing the relationship between the atmospheric temperature and the attentiveness pattern in *Prinia socialis*.

Breeding Biology of the Whitebreasted Kingfisher, *Halcyon Smyrnensis*

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Introduction

The Whitebreasted Kingfisher *Halcyon smyrnensis* is widely distributed throughout the state of Kerala woodlands, urban and suburban areas and watery habitats. Literature on the breeding biology of the bird is limited to observations by Ali (1969) and Zacharias and Gaston (1983). Hence an attempt has been made to study the breeding biology of the Whitebreasted Kingfisher.

Material and Methods

Perumthuruthy, 3 km from Tiruvalla, in the Kuttanad area of Kerala was selected as the main study site. Data were also collected from unmarked nesting sites in Kuttanad. The study was conducted from July, 1988 to December, 1991 on 38 nests in different stages.

The main nesting site, covered an area of 3 ha, with coconut groves surrounded by paddy fields. Breeding behaviour was studied using a pair of 7 ± 50 prism binoculars. The breeding territory was marked by noting the presence and activities of birds within the study area. From each nest, daily progress in building, egg laying, incubation, hatching and growth of nestlings, their development of feathers and general behaviour were recorded. Size and weight of eggs in different nests were taken. The weight of the nestling and their bill length were taken at an interval of 3 days. Incubation was observed for two hours in different parts of the day for two days continuously. The laying females were marked with coloured rings as sexual dimorphism was not distinct in the Whitebreasted Kingfisher. Continuous observations were made in four cases to determine the rate of nestling feeding. The fledgelings were observed till they attained self feeding stage.

Results and Discussions

Breeding season :

In the Whitebreasted Kingfisher, breeding activities started in January and ended in June, before the onset of monsoon in the study area. During the period of study, a total of 19 nests under construction were examined. Of them, 5 nests were excavated in January, 10 in February and 2 each in March and April. The last fledgling was found in the study area in June. Hence, the breeding season of Whitebreasted Kingfisher extended from January to June. The breeding season was so timed to escape heavy monsoons. The nestlings fledged at a time when the food was abundant in the breeding area.

Breeding age and pair bond

The breeding age of the Whitebreasted Kingfisher could not be determined correctly. It is likely that male and female kingfishers breed for the first time when they are in the second year of life which can be recognised on the basis of plumage and beak colours. These birds paired only for the breeding season and were solitary for the remaining part of the year. Display or courtship between the birds during non-breeding season was not observed.

Courtship and copulation

Initiation of pairing was indicated by 'laugh' which was usually produced by female sitting on high perch. Three birds producing such a call were caught and identified as females. Immediately after pairing the birds sat close together in the breeding area. In the Whitebreasted Kingfisher, during courtship 'wingspread' display and 'duet' calls were common.

Copulation was observed thrice during the entire study period. The act of copulation or mating in all the cases was preceded by 'wingspread' display which lasted for 3–15 minutes. After the display by two birds sitting close, the male mounted the female. The entire process lasted for a few seconds. In one instance a chase was observed before the copulatory display, while in the other two cases the birds were found sitting together.

Territory :

The Whitebreasted Kingfisher defended a breeding territory against other individuals. The territory 0.16 to 0.43 ha,was defended by chasing or attacking the intruders. The other kingfishers trying to feed in the area were attacked by the territory holder. The defence was more vigorous against conspecifics.

Nest and nest construction

The construction of the nest was done by the female alone. When the female was boring the nest, the male sat quietly very close to the nest site, watching the whole proceedings and surroundings. The nest site selection was also done by the female. The nest is usually bored in the soil. Of the 38 nests studied 37 were built in the soil and one on a hay stack. The bird, which nested in the hay, might have been an inexperienced female. Nest sites were always found on the vertical earthen walls of ponds and wells, elevated lands, banks of rivers and sides of any dug-out place. The presence of water was not a factor in the selection of nest site. The nests were located in coconut plantations, mixed plantations and paddy fields where 38 , 32 and 5 nests, were observed, respectively. The nesting sites in most cases were surrounded by paddy fields or open lands which formed the main feeding site of the kingfisher. Of the total nests observed, 68.42% were located in the side walls of dug-out places/elevated land,

26.32% on the vertical walls of ponds and wells and 2.63% on the banks of rivers.

The nest of the Whitebreasted Kingfisher was a round tunnel in the soil. The tunnel ended in an egg chamber, which had twice the diameter of the mouth of the tunnel. The tunnel was so constructed that eggs inside could not be seen from outside and rain water was prevented from entering into it. The tunnel was usually excavated at right angles to the bank and normally inclined about 30° towards a bulbous nest chamber at the end. The average length and diameter of 26 nests were 62.69 cm (40.2 to 99 cm) and 7.6 cm (7.3 to 8.8 cm), respectively (Fig.1).

In three cases, it took 8–20 days to complete the nest construction, the average being 10.33 days. Three nests under construction from first day of boring to their completion were observed thoroughly. The daily progress in the construction of the tunnel varied in different nests, and it was largely dependent upon the soil texture of the area. The boring of the nest was more active during the morning hours than the rest of the day. At noon the birds were found resting on trees near the nest site and the boring continued during the afternoon hours. Incomplete and partly bored holes, which were found near the live nest, indicated the selection of nest site for boring the tunnel.\

Nest desertion and reuse of nest

Three out of 27 nests studied were deserted. Two nests with eggs were deserted due to our study interferences and the other owing to the non hatching of eggs. No nest was found deserted during the nestling stage. In both the cases of nest desertion during egg laying reported, it has been observed that new nests were bored by the female to lay eggs to complete the clutch.

In the Whitebreasted Kingfisher, the previous years nests were reused by the breeding pair. Of the 9 cases observed, in 3 same nests were used for three years and in 6 cases same nests were used for the second year. The discarded or deserted nests were not used in the following year. It has also been observed that the same nest sites were used by some breeding pairs for boring new tunnels.

Egg laying

The egg laying started soon after the completion of nest. The eggs were laid in the afternoon probably between 12 noon and 2.30 pm in all the cases observed. In most cases the eggs were laid in consecutive days, but a few cases had a gap of 2 to 3 days. A gap of 3 days between the first and second egg was noticed in one case which had only two eggs in that clutch. In three cases a gap of two to three days was observed between the laying of last two eggs.

The egg of the Whitebreasted Kingfisher was glossy, immaculate white with smooth texture and almost round. The size ranged from 27.4 to 30.5 mm in length (average 28.9 mm) and from 23.1 to 26.66 mm in width (average 25.33 mm). The average weight of an egg was 10.54 g, (range 8 to 13 gm).

The clutch size in the Whitebreasted Kingfisher varied from 1 to 4, with an average of 2.53 (37 clutches). Of the 37 clutches scrutinised for clutch size, 11 had 4 eggs, 14 had 3, 8 had 2 and 4 had one egg.

Incubation and hatching

The incubation commenced only after the completion of the clutch. The eggs were incubated by the female. Identification of laying birds, which were ringed and shot later, indicated that only female incubated the eggs. When the bird entered the tunnel and remained in the egg chamber with eggs, it was considered as incubation. Field observations revealed that incubation was continuous with intermittent breaks for feeding. Continuous observations made at two nests for two days (1340 minutes), showed that the incubating females remained outside the nests for 96 and 86 minutes, respectively. At night the female remained in the nest.

The incubation period in the Whitebreasted Kingfisher was 18–21 days. Out of the 15 nests observed for determination of incubation period, it was 21 days in 6 cases, 20 days in eight cases and 19 days in one case. The average incubation period was 20.35 days.

Nestling and nestling period

The newly hatched chick was naked, flesh coloured and its eyes were closed. The brooding of the chicks continued for a whole day from hatching, may be to provide warmth to them. The hatching of the chicks and growth of the nestlings were synchronous in all the cases studied. But in one case asynchronous hatching and development were noted. The nestling period varied from 19 to 24 days (18 cases). At the time of hatching a nestling weighed 10.02 gm. The body weight of the nestling increased steadily from the day of hatching to the stage when they were 15 or 16 days old. In the last four days weight of the nestling decreased.

Feeding and nestling

The feeding and nestling were done by the female. The feeding frequency was higher in the morning and evening hours than during the rest of the day. Higher frequency of visit was always noted in the nest which had higher number of nestling. The food fragments found at the mouth of the nest hole included frogs, caterpillar, wings and exoskeleton of beetles and other insects, body parts of paddy crab, etc.

The nest sanitation and egg shell disposal

The nest of the Whitebreasted Kingfisher became dirty after the hatching of chicks with faecal matter crowded at its entrance. The nest chamber of the tunnel was free from excreta. This may be owing to the passing of excreta by nestlings into the mouth of the tunnel or faecal sacs were deposited at the entrance of the nest hole by the female. Egg shells scattered 10 to 15 meters away from the nest,

were noticed during our study period. However,the bird removing the egg shell was not observed.

Fledglings

The fledged bird had short tail, black beak with yellow tip, black feet and tarsus. The fledglings, after leaving, did not return to the nest . They were fed only by the female. However, the guarding of fledglings was done by both sexes. The fledglings started foraging on their own when about a month old .

Breeding success

The breeding success in this bird is summaried in Table 1. Totally 37 nests were examined during the study period from 1988 to 1991 and they produced 71 fledglings. Thus a pair of the Whitebreasted Kingfisher raised 1.92 fledglings on an average. Of the total eggs, 84.91 per cent hatched and of these nestlings, 85.55 per cent became juveniles. These results suggested that the Whitebreasted Kingfisher had a very high breeding success.

The Whitebreasted Kingfisher started breeding before early showers in April. This bird is considered to be a premonsoon breeder by Zacharias and Gaston (1983), based on their observations on the breeding seasons of birds at Calicut, Kerala. The peak nesting of the Whitebreasted Kingfisher extended from March to May, which is the premonsoon period. The main reason for the premonsoon breeding by an insectivorous species is the abundance of insects. On account of early rains, grasses sprout and insects become more abundant. By the time the eggs hatch the nestlings fledge, the monsoon will have increased intensity ensuring the steady supply of food for weeks to come. Owing to the onset of monsoon, streams, canals and paddy fields become water-logged which also provide enough fish for the fledglings. Therefore, it appears that the timing of breeding in the Whitebreasted Kingfisher in the study area is related to the availability of the food and onset of monsoon. The proper timing of the breeding activities is important for the survival of kingfishers. As they are hole nesters on the ground, the nestlings have to leave the nest before the peak of monsoon. A survey of the nesting area and other places in Kuttanad showed that all the low areas are covered with water during the peak monsoon months and the nest holes and sites are submerged. Hence, it appears that onset of southwest monsoon (May to September) also has some role in determining the nesting season of this bird. Variation in the timing of breeding is due to a factor like rainfall (Zwickel, 1977). Similar observations were made by Shukkur and Joseph (1980) and Zacharias and Gaston (1983).

The nest of the Whitebreasted Kingfisher is a tunnel in the vertical earthen wells. Ali (1969) observed that all the species of kingfishers inhabiting the state of Kerala built their nest in a hole on earthen walls. In the Mangrove Kingfisher, the nest is built on a termite mound (Miller, 1937). Davis and Graham (1991) observed that in the Amazone Kingfisher the nesting was on river banks. The hole nesting is considered to be an adaptive behaviour of different species of kingfishers. The nest site of the Whitebreasted Kingfisher is located in places where large quantity of food is available. Most of the nest sites observed in the entire study period were surrounded by or very near to paddy fields or open ground which formed the feeding ground of the kingfishers. Morgan and Glue (1977) noted that *Alcedo atthis* bred near water where there was readily available source of food.

The size of the territory of the whitebreasted kingfisher was small. Territorial behaviour was observed in the African species of Kingfishers by Miller (1937) and Milestein (1962). Defence of territory was noted in other species of kingfishers by Jackson (1938), Greig-Smith (1978b), Davis (1982) and Brook and Davis (1987). In the Whitebreasted Kingfisher also, the breeding territory is vigorously defended particularly against conspecifics. The hatching of the eggs in the Whitebreasted Kingfisher was synchronous in all the cases except one. The nestlings gain by the synchronous hatching as they may not be starved. When starved, a passerine nestling dies very quickly (Lack and Lack, 1951; Skagen, 1988). The survival of the chick was significantly higher in synchronous hatching (Bollinger *et al.*, 1990). Variation in the incubation period was about 3 days in the Whitebreasted Kingfisher. Skutch (1976) and Ricklefs and Samaraski (1983) stated that typical variation in incubation period appears to be two days for many passerines. Hence, the variation in incubation of the kingfisher observed is normal. The nestling of the Whitebreasted Kingfisher showed rapid development. The Whitebreasted Kingfisher had a high breeding success. The reasons may be the favourable nesting season , efficient incubation, availability of adequate food and minimum predation. Murton and Westwood (1977) relates low hatching success in Wood Pigeon to inefficient incubation. The nestling loss in swifts occurs due to starvation (Lack and Lack, 1951). Similar starvation deaths were reported in South-West Ecuadorian birds by Merchant (1960) and in bulbuls by Vijayan (1980). The death due to starvation in the Whitebreasted Kingfisher is completely prevented by breeding in the best season of the year. The low fledgling success in bulbuls is related to predation (Vijayan, 1980). The absence of a second brood in the Whitebreasted Kingfisher is perhaps compensated by the high rate of success of the only brood raised with virtually no predation.

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Table I : Breeding success in the Whitebreasted Kingfisher

Halcyon Smyrnensis Fusca

Observation	1988	1989	1990	1991	Total
No. of eggs laid	26	26	45	15	106
No. of eggs hatched	2	3	7	4	16
% eggs hatched	90	88.4	84.4	73.3	81.9
No. of Nestlings	18	22	32	11	83
No. of Nestlings fledged	15	17	28	11	71
% survival	83.3	77.2	87.5	100	85.5

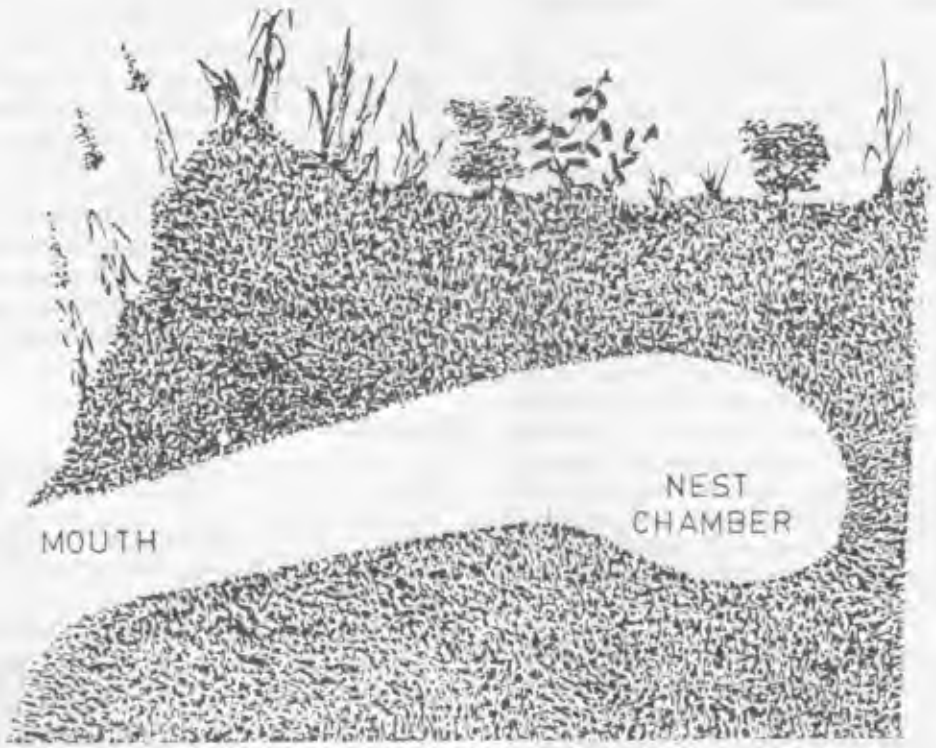

Fig.1 : Diagrammatic representation of the cross section of the nest hole of the Whitebreasted Kingfisher

Brood Size Distribution Patterns in Animal Dispersed Plant Species

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Brood size is one of the important life history traits for the plant because of it's immediate implication on fecundity component of plant fitness. There are several selective forces viz., dispersal, seedling fitness, predation and packing cost shaping the size of a clutch in a plant species. (Hegde *et al.*, 1991). Dispersers, generally appear to be important driving force in shaping the brood size in animal dispersed plant species.

Based on the type of preference criterion employed by the disperser, brood size varies in plant species (Ganeshaiah and Uma Shankar, 1991). The present study surveys the natural distribution of brood sizes in plants and tries to make few predictions for observed distribution patterns.

Ninety eight animal dispersed species were identified from forest belts of Karnataka and Tamilnadu. These species belong to 31 families and 57 genera, comprising of Lianas (4), herbs (2), shrubs (23) and trees (69). Observation were recorded on fruit diameter, fruit weight, seed number, seed weight, pulp weight, pulp to seed ratio and average seed weight. While analysing for brood size distribution, seed weight distribution was considered in case of single seeded species.

Our analysis indicated that majority of the species showed normal distribution for seed weight (Fig.1) and seed number (Fig.2) with very few species falling into positive and negative skewness classification. Animals primarily base their preference on fruit diameter, which indirectly brings about change in associated characters.

The fruit diameter associations with other fruit characters revealed that both with single and multiseeded species fruit diameter is positively associated with seed weight, seed number, Pulp weight and P/S (Fig.1a, 1b, 1c and 2a, 2b, 2c).

From the association analysis we make the following predictions for observed seed weight/number distribution.

1. Normal distribution of seed weight/seed number is the outcome of birds effort to maximise benefit over cost of handling the fruits. However, operation of other selective forces are not completely ruled out.
2. Seed number and seed weight will be positively skewed if the preference is based on the palatability of the fruit (pulp weight to seed weight ratio, P/S). However, our study reports significant positive association between seed weight/seed number with P/S. It is quite possible that other selective forces like predation or other environmental variables might be the significant force than the preference criterion.
3. Seed number and seed weight would be negatively skewed if the preference is based on the total pulp harvested (pulp weight).

Hence, we can predict that in case of plant species having single seeded fruits, birds base their preference mainly on benefit to cost ratio, followed by other factors, while total pulp content is the least preferred. In case of multiseeded species preference is based on B/C, followed by total pulp content and then other selective forces.

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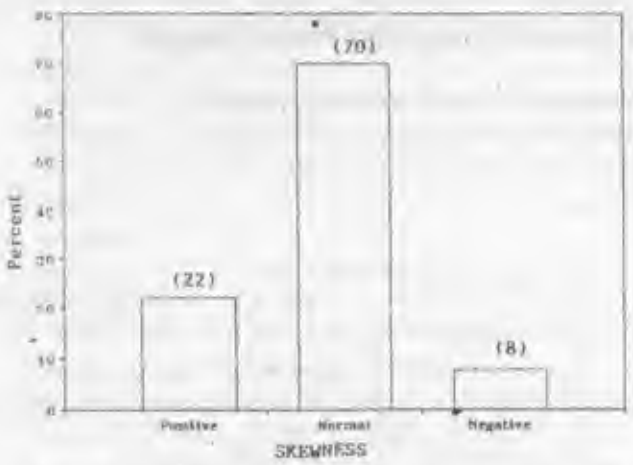


Fig 1a: Seed weight distribution in single seeded plant species (n = 46)

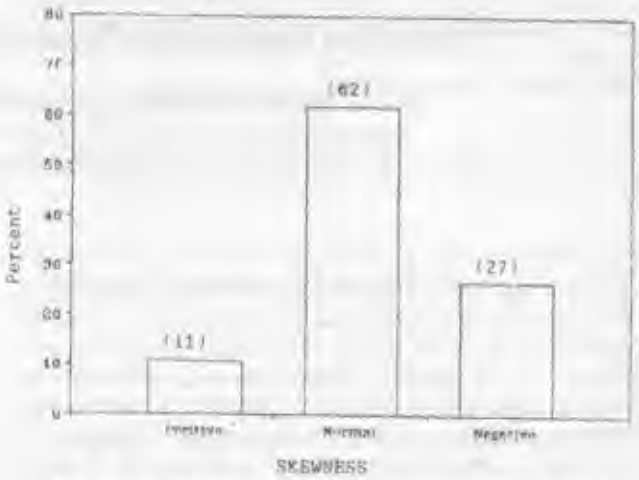
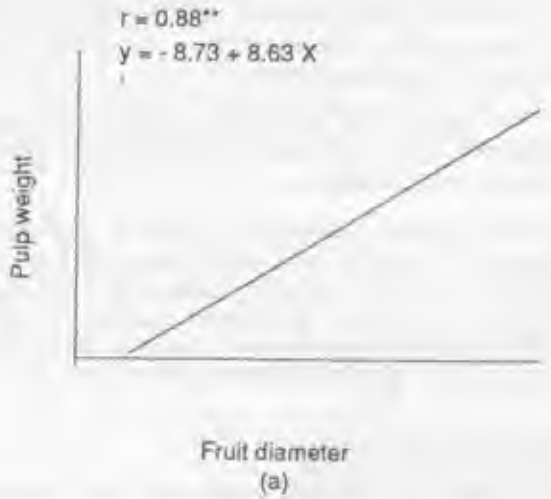
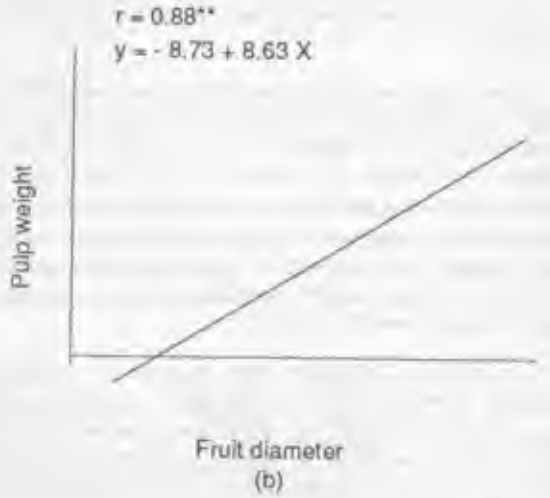
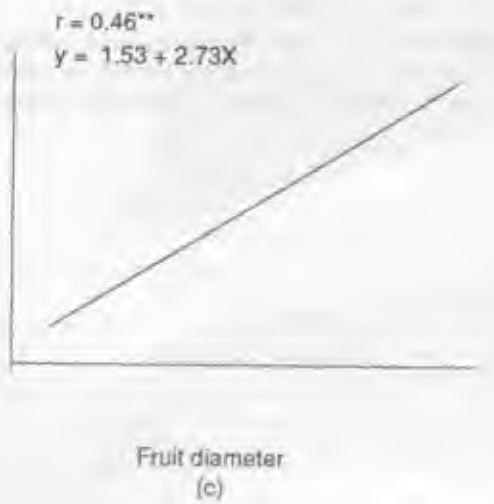


Fig. 1b: Seed number distribution in multiseeded plant species (n = 52)







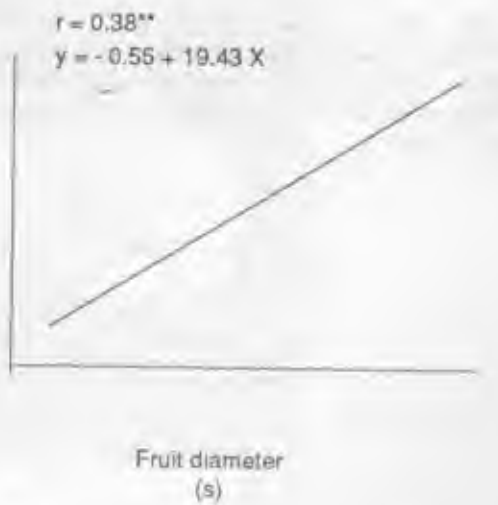


Fig.2: Character associations

a, b, c : Single seeded species
d : Multi seeded species

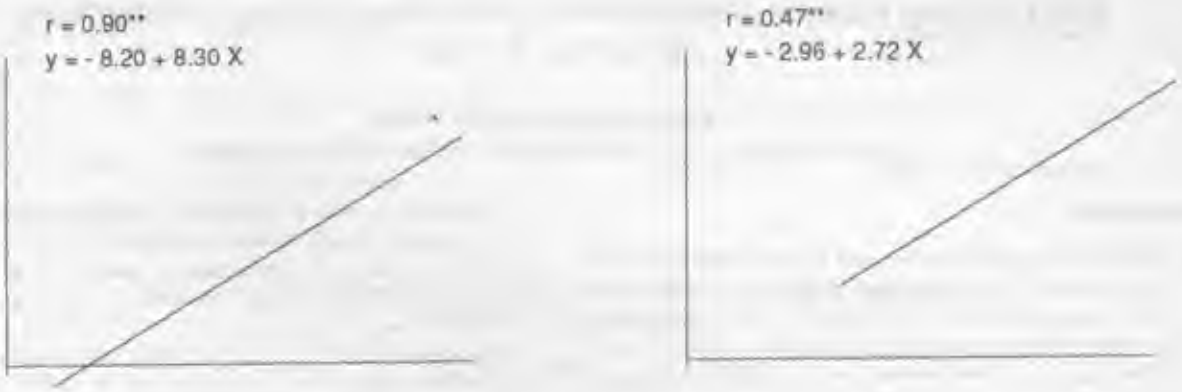


Fig.2: Character associations

w, d : Multi seeded species

Birds Visiting Flowers of Indian Silk Cotton Tree (*Bombax malabaricum*) at Calicut, Kerala

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Introduction

Though the importance of insects in pollination of flowers is well known, little information is available on the role of birds in the pollination (Subramanya and Radhamani, 1993). The Indian silk cotton tree (*Bombax malabaricum*) (Bombacaceae) is a lofty, deciduous tree widely distributed in India and is conspicuous by its profuse flowering on leafless branches during summer when it attracts birds for nectar. Ali (1932) observed 41 species of birds visiting the tree for nectar in the Bombay region of Western India. However, no information appears to be available on the bird visitors of the tree in other parts of the country including Kerala. Hence, observations were undertaken on the birds visiting *B.malabaricum* for nectar at Calicut (Kozhikode district, Kerala) and the results are reported here.

Material and Methods

Observations on bird visitors to flowers of *B.malabaricum* were made at the campus of National Research Centre for Spices at Calicut during January–April 1991 and 1992. The birds were observed for their activity and identity with the naked eye and also by using a pair of 7 ö 35 binoculars. For observing the relative diversity and frequency of bird visitors during different periods of the day, various birds available on a single isolated tree at 9.00, 11.00, 13.00, 15.00 and 17.00 hours for 3 days during the peak flowering phase in 1992 were counted.

Results and Discussion

Twenty three species of birds belonging to 12 families visited flowers of *B.malabaricum* for nectar (Table 1). Among them, the Greyheaded Myna (*Sturnus malabaricus*) was the most common accounting for 62.6 per cent. The Redwhiskered Bulbul (*Pycnonotus jocosus*) and the Jungle Crow (*Corvus macrorhynchos*) were also common accounting for 11.1 and 9.7 per cent, respectively. The other species were less common accounting for 16.6 per cent of visitors combined together. The Greyheaded Myna always visited the tree in small flocks and this could be the reason for their relatively higher abundance. Ali (1932) also mentions that these three species of birds were very commonly seen on the tree in the Bombay region; however, the most common bird was the Rosy Pastor (*S.roseus*).

In addition, birds like Bluetailed Bee-eater (*Merops philippinus*), Small Green Bee-eater (*M.orientalis*), Pygmy Woodpecker (*Dendrocopus nanus*) and Leaf Warbler (*Phylloscopus* sp.) were seen on the tree. These were probably attracted to the insects around the flowers.

Bird activity was higher during morning, late morning and evening hours when compared to other periods probably because of higher nectar availability and cooler temperatures during these periods. The percentages of birds observed during 9.00, 11.00, 13.00, 15.00 and 17.00 hours were 27.3, 21.8, 16.6, 15.2 and 19.0, respectively. A similar result was also obtained by Ali (1932) on birds visiting the Indian Coral Tree (*Erythrina indica*).

The flowering of *B.malabaricum* provided an important source of food and energy for birds in this region especially during the early summer season. In recent years, a large number of silk cotton trees are being cut especially in semi-urban and rural areas for various developmental activities, thus depriving the birds of an important source of food especially during the summer period.

Acknowledgments

We are thankful to Shri K.S. Sreekumaran of NRCS,Calicut,for typing the manuscript.

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Table 1 : List of birds visiting flowers of Indian Silk Cotton tree at Calicut

Family/Species	Common name
Psittacidae	
Psittacula krameri	*Roseringed Parakeet*
Loriculus vernalis	*Lorikeet*
Capitonidae	
Megalaima viridis	Small Green Barbet
Picidae	
Dinopium benghalense	Goldenbacked Woodpecker
Oriolidae	
Oriolus oriolus	Golden Oriole
O. xanthornus	Blackheaded Oriole
Dicuridae	
Dicrurus adsimilis	Black Drongo
D.paradiseus	Racket-tailed Drongo
Sturnidae	
Sturnus malabaricus	Greyheaded Myna
Acridotheres tristis	Common Myna
Corvidae	
Dendrocitta vagabunda	*Tree pie*
Corvus splendens	*House Crow*
C.macrorhynchos	*Jungle Crow*

Irenidae

Chloropsis aurifrons	Goldfronted Chloropsis

Pycnonotidae

Pycnonotus jocosus	Redwhiskered Bulbul

Muscicapidae

Turdoides striatus	Jungle Babbler
T.affinis	Whiteheaded Babbler
Orthotomus sutorius	Tailor bird
Copsyshus saularis	Magpie-Robin

Nectariniidae

Nectarinia zeylonica	Purplerumped Sunbird
N.asiatica	Purple Sunbird
Arachnothera longirostris	Spiderhunter

Ploceidae

Passer xanthocollis	Yellowthroated Sparrow

Table 2: Abundance and activity pattern of birds visiting flowers of Indian silk cotton tree at Calicut

Period (hrs)	Major bird species			Other species	Total
	GM	JC	RB		
9.00	17.0	3.7	0.7	5.0	26.3
11.00	14.3	0.3	2.0	4.3	21.0
13.00	9.7	0.3	3.3	2.7	16.0
15.00	9.0	0.7	2.3	2.7	14.7
17.00	10.3	5.7	1.0	1.3	18.3
Total	60.3	10.6	9.3	16.0	96.3

GM = Greyheaded Myna; JC = Jungle Crow; RB = Redwhiskered Bulbul

Figures indicate number of birds observed (mean of 3 days)

To be on the Right Size : Bird Preference and Seed Dispersal

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Some of the selective forces which shape clutch size and seed size in bird dispersed plant species are :

1. Packing cost — As the clutch size increases, packing cost per seed decreases consequently selection favours evolution of larger clutch size (Ganeshaiah *et al.*, 1988).
2. Seedling establishment — As seed size increases, offspring fitness increases and hence selection favours for larger seed size. The maternal parent tries to optimize seed size which often conflicts with the offspring optima, thus effecting seed size and number. (Smith and Fretwell, 1974).
3. Predation — Based on the extent of predation some species vary their clutch size to save seeds from predation (Godfray *et al.*, 1991).
4. Preference criteria of birds — Another major selective force is the preference criterion adopted by birds while foraging on fruits. These preferences may be broadly classified into three distinct criteria based on :
   a) Pulp to seed weight ratio (P/s, Palatability)
   b) Total pulp weight
   c) Benefit to cost ratio of handling the fruits (b/c).

Preference based on total pulp content

Preference of birds for fruit with high pulp content might lead to selection for increased seediness of fruits, since the absolute pulp content is positively correlated with seed number (Figures 2a and b).

Preference based on pulp to seed weight ratio: Preference of birds for fruits having high pulp to seed weight ratio might lead to selection for decreased seediness of fruits since P/s is generally negatively associated with seed number and seed weight (Fig.1a and b).

Preference based on benefit to cost ratio of handling the fruits : Preference of birds based on maximizing the pulp reward (benefit) in a minimum of handling time (cost), might lead to selection of an optimum seed weight/number that may vary anywhere from smaller brood to larger brood depending on species of the bird and plant involved in the interaction

In all the above mentioned studies, experiments were limited only to specific cases of frugivore and plant species. In this paper we have discussed preference criteria of birds and their influence on brood size of plants species.

The natural distributions of clutch size were studied in 98 animal dispersed plant species. Of these 46 species were single seeded and 52 many seeded. Analysis showed that majority of the species had normal distribution for seed number and seed weight; only a few species were in the positive and negative skewness classification

To test the effect of bird preference on the natural distribution of seed size and number, we studied 5 wild, animal dispersed species in vivo at GKVK, UAS, Bangalore during September to April 1992–93. (Table 1).

If bird preference is the major selective force acting in shaping the seed weight and number distributions, we expect as per the predictions that fruits having seed weight or seed number coinciding with the mode of the natural distribution preferentially picked by birds.

Our analysis of crop removal data by animal/bird under field condition did not show any specific pattern for fruit size. The reason for such non significant correlation between crop removal percentage and fruit diameter could be due to involvement of more than one dispersal agent on a plant species, each disperser, employing different criteria of selection. It is equally likely that premium put on other selective forces in some plant species undermines the effect of bird preference or it may be combination of both.

Field study was extended to laboratory condition with only one plant species *Solanum pimpenellifolia* and its disperser, the Redvented Bulbul (*Pycnotus cafer*). In 13 trials conducted three fruits belonging to three different classes were offered to the bird at a time in different combinations ($5C_3$). The bird was allowed to pick one fruit and its handling time was recorded to the nearest second. The frequency of picking was tabulated against the different size classes (Table 2).

Experiments showed that the size class most often picked by the bird apparently gave highest b/c of handling the fruit. This class was also found to coincide with the peak of the natural distribution of fruit diameter

Inspite of the positive results obtained in the *In vitro* studies, *In vivo* studies gave inconclusive results. Hence, more extensive work is required in this direction before we can conclude whether or not there is any one major selective force out of the three preference criteria shaping the brood size or if all are used randomly. Studies are in progress.

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Table 1: List of the species studied *In vivo* to estimate the crop removal under field condition.

Species	Seed number	N	Duration of study (Days)	r_1	r_2
Zizyphus	1–2	22	45	0.498*	0.23^{NS}
Scutia	1–2	6	60	0.508*	0.10^{NS}
Canthium	1–2	6	60	0.688*	0.15^{NS}
Cippadesa	1–6	9	60	0.534*	0.26^{NS}
Solanum	5–57	9	30	0.614*	-0.17^{NS}

r_1 = Correlation coefficient between fruit diameter and seed weight (Seed number is *Solanum*)

r_2 = Correlation coefficient between fruit diameter and per cent crop removal

Table 2: Handling time of various fruit size classes experienced by the bird, Redvented Bulbul in the laboratory

Size class	Fruit Size (mm)	*Trials N = 13*	*Handling time (Sec.)*
1	7.0 – 8	0	–
2	8.1 – 9	2	3
3	9.1 – 10	6	5
4	10.1 – 11	3	9
5	11.1 – 12	2	14

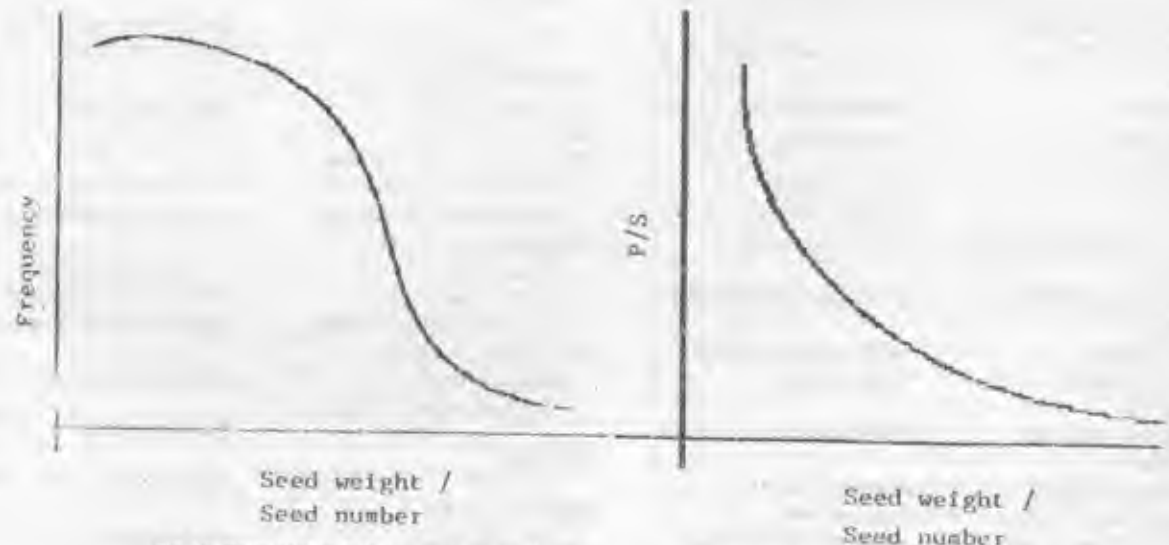

Fig 1a. Relationship between pulp to seed ratio (P/S) and frequency observed for animal dispersed plant species.

Fig 1b. Predicted frequency distribution of seed weight or seed number, if birds base their preference on palatability.

Birds — Some Striking Behaviours

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Introduction

Descriptions of some bird-behaviours that appeared interesting are reported in this paper.

Material and Methods

Urban birds were observed for the last ten years from my residence extending about 3000 sq ft, on a main road linking greater Calcutta with Southern part of the State — the much famed Sunderban forests and the Bay of Bengal. The area is thickly populated area. The garden has trees such as Red silk cotton Tree (*Bombax malabaricum*), Eucalyptus, Neem (*Azadirachta indica*), Chalta (*Dillenia indica*), Jamun (*Eugenia jambolana*), etc. The others are climbers and shrubs. To the immediate north of the garden are four ponds with clear water and trees growing all around and plenty of fishes such as Snake-Head (*Channa marulius*), Tilapia (*Tilapia mossambica*), Magur (*Clarius magur*), Singhi (*Heteropneustes fossilis*) etc. Along with fishes, the ponds have snakes such as, Striped Keelback (*Amphiesma stolata*), Green Keelback (*Macropisthodon plumbicolors*), Checkered Keelback (*Xenochropis piscator*), Olive Keelback(*Atretium schistosum*), Common Wolf Snake (*Lycodon aulicus*), Common Worm Snake (*Typhlina bramina*), etc.

Beyond the south-east of the garden are small villages. The west and north-west face the city of Calcutta and some portions of marshlands of Salt Lake, a bird-haven now almost extinct.

Results and Discussion

The birds that visited the garden were as follows :

PHALACROCORACIDAE	
Little Cormorant,	*Phalacrocorax niger*
ARDEIDAE	
Pond Heron,	*Ardeola grayii*
Cattle Egret,	*Bubulcus ibis*
ACCIPITRIDAE	
Pariah Kite,	*Milvus migrans*
Shikra,	*Accipiter badius*
Indian Whitebacked Vulture,	*Gyps bengalensis*
RALLIDAE	
Whitebreasted Waterhen,	*Amaurornis phoenicuras*
COLUMBIDAE	
Spotted Dove,	*Streptopelia chinensis*
Blue Rock Pigeon	*Columba livia*
PSITTACIDAE	
Roseringed Parakeet,	*Psittacula krameri*
CULCULIDAE	
Piedcrested Cuckoo,	*Clamator jacobinus*
Common Hawk Cuckoo,	*Cuculus varius*
Indian Plaintive Cuckoo	*Cacomantis merulinus*
Indian Koel,	*Eudynamys scolopacea*
Coucal,	*Centropus sinensis*
APODIDAE	
House Swift,	*Apus affinis*
ALCEDINIDAE	
Whitebreasted Kingfisher,	*Halcyon smyrnensis*
Brownheaded Storkbilled Kingfisher,	*Pelargopsis capensis*
Pied Kingfisher	*Ceryle rudis*
Common Kingfisher,	*Alcedo atthis*
MEROPIDAE	
Little Green Bee-eater,	*Merops orientalis*
CORACIDAE	
Indian Roller,	*Coracias bengalensis*
CAPITONIDAE	
Crimsonbreasted Barbet,	*Megalaima haemacephala*
Bluethroated Barbet,	*Megalaima asiatica*
Green Barbet,	*Megalaima zeylanica*
PICIDAE	
Goldenbacked Woodpecker,	*Dinopium bengalensis*
Maharatta Woodpecker,	*Dendrocopos mahrattensis*
Fulvousbreasted Pied Woodpecker,	*Dendrocopos macei*
Scalybellied Green Woodpecker,	*Picus xanthopygeous*
LANIDAE	
Brown Shrike,	*Lanius cristatus*
Baybacked Shrike ,	*Lanius vittatus*
Rufousbacked Shrike,	*Lanius schach*
ORIOLIDAE	
Blackheaded Oriole,	*Oriolus xanthornus*
DICRURIDAE	
Black Drongo,	*Dicrurus adsimilis*
STURNIDAE	
Pied Myna,	*Sturnus contra*
Common Indian Myna,	*Acridotheres tristis*
Jungle Myna,	*Acridotheres fuscus*
Greyheaded Myna,	*Sturnus malabaricus*
CORVIDAE	
Indian Tree Pie	*Dendrocitta vagabunda*
House Crow,	*Corvus splendens*
PYCNONOTIDAE	
Redvented Bulbul,	*Pycnonotus cafer*
MUSCICAPIDAE	
Sub Family : Muscicapinae	
Redbreasted Flycatcher,	*Muscicapa parva*
Greyheaded Flycatcher,	*Culicicapa ceylonensis*
Sub Family : Sylvinae	
Tailor Bird,	*Orthotomus sutorius*
Dusky Leaf Warbler,	*Phylloscopus fuscatus*
Greenish Willow Warbler,	*Phylloscopus trochiloides*
Sub Family : Turdinae	
Magpie Robin,	*Copsychus saularis*
Orangeheaded Ground Thrush	*Zoothera citrina*
PARIDAE	
Grey Tit,	*Parus major*
MOTACILLIDAE	
White Wagtail,	*Motacilla alba*
Indian Pipit,	*Anthus novaeseelandiae*
DICAEDAE	
Thickbilled Flowrpecker,	*Dicaeum agile*

Tickell's Flowerpecker,	*Dicaeum erythrorhynchos*
NECTARINIDAE	
Purple Sunbird,	*Nectarina asiatica*
Purplerumped Sunbird,	*Nectarinia zeylonica*
PLOCEIDAE	
Indian House Sparrow,	*Passer domesticus*
Spotted Munia,	*Lonchura punctulata*
Baya Weaver,	*Ploceus philippinus*

A total of 59 species of birds were recorded between November 1982 and August 1993. Among these, many are resident and common. Some are migratory and sporadic. A few are breeding species, i.e. noted only during their breeding season. The rest are rare, but arrives atleast once or twice a year.

Following are some interesting notes

Little Cormorants have been noted chasing domestic ducks and trying to swallow snails (*Pila globosa*) given to the ducks by the farmers. Some even tried to eat cereals and grains mixed with rice-bran, commonly used as duck food.

A couple of Pond Herons favoured electric illumination. After sun set the pair arrived under the lamp post at the pond side, and preyed on small frogs, termites, and once killed a Little Grey Musk Shrew (*Suncus murinus*), although it was not devoured.

A Cattle Egret on a buffalo picked leeches (*Hirudinaria* sp.) and most part of the day combed the buffalo's forehead. When the bird was joined by a couple of Common Indian Mynas, the buffalo showed dislike by lashing its tail.

A Whitebreasted Waterhen, once managed to build a nest inside a big cucumber vine, near a pond. As the chicks were a couple of weeks old, the master of the garden noticed the bird's nest, and went to catch the chicks. As he approached the nest site, the hen bird, sent a loud cry, and the cock bird crouched beneath the nest. The man mistakably, rushed towards the noisy bird, while the black chicks smartly landed on the cock's back, one after another, and swiftly ducked beneath a sheet of floating hyacinth.

A pair of Spotted Dove, lived in our verandah, and raised 32 chicks out of 42 eggs, between 1990 and 1992. The nest was created on an old verandah beam, overlooking the compound. In hot summer middays the doves would enter my study, ignoring my presence, skipped to the window beam and enjoyed the shade and cool breeze of the ceiling-fan, resting and preening with soft notes exchanged at regular intervals. The birds would remain, till about 4 p.m. and leave after I fed them with rice or seeds.

A pair of Roseringed Parakeet lived in a hole of a coconut tree. The man of the garden, while collecting the coconuts noted the parakeet nest and put his hand into the hole to bring out the chicks. The adult birds watched the man from an upper branch of the tree and suddenly dived down and pecked the man's nose. The female bird scratched the man's head and dislodged his turban. The next six or seven months, the man was repeatedly attacked by the same pair whenever he approached the tree. But when another man was asked to climb the same tree, the birds sat patiently as he plucked the coconuts. Do birds have the sense to identify humans ?

A pair of Indian Koel was seeking a chance to place their eggs in a Crow's nest on the lower branches of a Jamun tree. Every afternoon the pair arrived and failed in their mission as the crows were alert. After a week's vain attempt, the male Keol, appeared right amidst the crows and flung away the nest with its beak and wings and dashed away never to return. The crows collected the nest materials again to build a new nest, but lost the eggs that fell and broke.

A large number of Coucals were found in the study built area. They nest in the date palm trees. An adult bird was once found collecting a big ball of thrown away wool. I watched it carrying away the chords to its nest. The next day I deliberately left some more wool on its way. The birds did not touch it, but collected a green string instead. The wool I had given, was bright red, and the wool it had carried the previous day was of a green shade too. I tested with some green wool the following day. The bird readily accepted it. Are Coucals colour conscious ?

House Swifts are known to build nests in crevices and roof tops. A pair of House Swift opted to build their nest, inside an iron pipe of the water reservoir on the terrace of a neighbor. Somehow the water level of the tank reached a height as to wet the nest. The birds collected some muddy substance and immediately sealed all the pipes and that drew the attention of the land-lord too.

A Common Kingfisher was seen picking fish from a fisherman's basket at regular intervals. House Crows are most reputed for their tricks. A crow carried away all perfumed material, such as bath soaps, perfumed hair oil-lids, small bottles of perfumes and even the wrap paper of any perfumed materials. Another crow had a fascination for ladies bangles especially, if they were red. It lifted small ornaments, tin plated combs and hair clips and shining lipsticks. An abandoned crow nest discovered in our coconut tree, had the following: A metal spoon, a piece of magnet, a 'Nivea' cream container, a 'Binaca' tooth-brush, a fountain pen, a single surgical glove, four playing cards a photograph of Ramakrishna Paramahamsa, small lengths of electric wires, a plastic doll, twines and jute fibres, shoe-lace, colorful kite papers, broken broom sticks and small twigs of Jamun tree.

My grandma lived in a big room with big spacy windows and the ceiling covered with bamboo mat. Inside this huge mat, lived a big colony of house sparrows. They collected various soft materials, and tucked their untidy nests inside the mat so that it is not visible from outside. They lived for thirty years, generation after generations and my grandma never bothered about their presence. When in 1980 grandma passed away, the birds very stopped arriving to their thirty year's nest site and abandoned the huge nests forever. It is still a mystery to me, as to why the sparrows vanished soon after the owner of the room passed away, despite our every effort to keep them in their place, with regular feedings and keeping the windows open so that they might remain unobstructed.

The above observations are from my records maintained from 1981–92.

Two Unusual Nesting Sites of the Redvented Bulbul (*Pycnonotus cafer*)

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The Redvented Bulbul *Pycnonotus cafer* (L) (Ord. Passeriformes: Fam. Pycnonotidae) and other members of the Pycnonotidae are known to inhabit and construct nests in bushes and trees at the height of 1 to 3 meters, in forests, semideserts, cultivated lands and gardens close to human habitation. There are no reports of these birds building nests inside human dwellings and also in bushes close to the ground. The present paper describes two such nesting sites of the Redvented Bulbul, *Pycnonotus cafer*, in Dharwar city (15° 28' N and 75° 01' E) (Karnataka State). Following are the details of the same.

A pair of *P.cafer* has been building nests in the sit- out room of our house (14.0' ± 9.5' ± 10.5') for the last four years. One window and the ventilators are kept open at all times and they served as a free passage for these birds. From the centre of the ceiling of this room is suspended a 2' long chandelier having wide central ring with radiating metal spokes with pendant glass beads (Photograph 1). The birds have been using this chandelier's central ring as a safe platform for nest building all these years. Photograph 2 shows three nests, one constructed last year (a), and the other two (b and c) constructed in February and April of this year, for the first and second clutches, respectively.

The second site selected by another pair of *P.cafer* is a bush of *Ixora* sp. grown in the quadrangle of our Zoology Department. The nest is constructed in the bush at the forking point of the branches, hardly 2.5' off the ground. Being covered on all the sides by the thick foliage it is protected from the winds, rains, direct sunlight and from predators. (Photographs 3 and 4).

The above findings indicate that this bird is getting more acquainted with man.

Explanation of photographs

1. Sit-out room showing the chandelier where the nests are constructed. One adult Pycnonotus cafer can also be seen at the nest.
2. A close up view of the chandelier showing, (a) one nest of April, 1992; (b) another nest of February, 1993 for the first clutch; and (c) a third nest of April, 1993 for the second clutch. One egg (e) can also be seen in the nest.
3. A thick-foliage of Ixora sp. bush completely covering the nest of *P.cafer.*
4. The branches of Ixora sp. bush are spread apart showing the nest of P.cafer with two eggs.

Use of Line Transects to Estimate Indian Robin (*Saxicoloides fulicata*) Population at Pondicherry University Campus

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Introduction

Monitoring populations of certain indicator species of a habitat could serve in developing conservation strategies for the habitat.

The Indian Robins (*Saxicolodes fulicata*) is one such and can be estimated by simple line transects.

Material and Methods

The study was conducted at Pondicherry University. Stratified random sampling using variable width transacts was employed. The university campus was stratified according to the habitat into 4 areas. The areas and the length of the transects laid in each are given in Table 1. The assessment of vegetation for habitat stratification was done by laying a series of parallel transects and then measuring the areas covered by each type on a map.

All the transects were traversed twice in the morning between 6.00 a.m. and 7.00 a.m. and once in the evening (1600 to 1700 hrs) at a constant pace of 1.0 km/hr. All visual sightings of Indian Robins were noted, the angle of sighting q, distance of sighting y, the length on the transect line to the point perpendicular to the sighting of the bird x were measured in metres. Thus the perpendicular distance of the bird to the transect line was obtained by averaging y Sin q and x Cos q.

The data thus collected was analysed by Emlen strip width method and again by the Fourier series estimator. Data for Whiteheaded Babbler (*Turdoides affinis*) were also collected for comparison.

Results And Discussion

The average group size for the Indian Robins was 1.24 æ 0.49 (n = 41). Using the Emlen strip width method, a group density of 192.766/km^2 was obtained. Thus there were about 239.498 Robins per sq km while using the Fourier series estimator a group density of 210.369 /sq km, i.e., a density of 261.74 Robins per sq km was obtained.

The average number of males per sq km was 150.30, which was got by the product of the sex ratio (1.5:1.0) with the mean density. Thus each male could stake a territory of 6650 sq km, about the size of a football field. The territorial area estimate should be considered with certain caution because firstly not all males will be breeding and moreover territories may overlap.

The densities of the Whiteheaded Babblers (*Turdoides affinis*) was also estimated in the same way. Mean group density was 248 /sq km. Thus, with an average group size of 4.125 æ 3.58 (n = 31), we get a mean density of 1023 /sq km.

The use of line transacts to estimate populations of Indian Robins seems to be justified.

On the other hand, the transect methodology for babblers (which are gregarious and move about a lot) seems to give an over estimate. A study of the Whiteheaded Babblers in South India gave a density of just 60 birds per sq. km (A.J. Johnsingh *et al.*, 1982). The over estimate may be due to the shy nature of the Babblers causing movement due to observer disturbance. This must have led to many recounts thus the line transact methodology does not suit all species of birds and other techniques like spot-counts, mark-recapture, etc. must be applied.

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Table 1

Habitat Type	Area (sq. km)	% Cover of total campus area (sq. km)	Transect No.	Length (km)	% of total
A	0.0162	11.0%	T1 180° S	0.114	10.95
B	0.0504	37.8%	T2 270° W	0.276	26.51
			T6 225° SW	0.120	11.52
C	0.216	16.3%	T3 145° SE	0.171	16.43
D	0.495	34.9%	T4 90° E	0.150	14.41
			T5 90° E	0.210	20.17

A = Modified scrub, *Phoenix humilis* and *Anacardium occidontale*
B = Open grasslands of *Arishda* sp.,, *Heteropogon*, *Perotis indica* and *Apluda mutica*
C = Dense Wooded area of *Azadiracta indica* and *Anacardium occidantale*
D = Ravine dry open scrub dominated by *Phoenix humilis* and *Borasous flabellifer*

Observations on Nest-building Behaviour of the Small Blue Kingfisher (*Alcedo athis*) at Keoladeo National Park, Bharatpur

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The nesting season of the Small Blue Kingfisher is from March to June (Ali, 1979). The observations sited here were made on the 19th March 1983 on a nest of the Small Blue Kingfishers (*Alcedo athis*) at Keoladeo National Park, Bharatpur, using a pair of 7x50 binoculars and a wrist watch. The nest hole was situated on a dyke. The entrance to the tunnel was about 2.5 inches wide situated three feet above the water level. Activities were recorded for three hours. The feeding of an adult female bird by the male during the breeding season is known as Courtship feeding. Courtship feeding takes place not only during pair formation (as the name suggests) but also during nest construction, egg laying, incubation and other phases of the breeding season. Courtship feeding was observed in the Small Blue Kingfisher. It was seen thrice — at 0750 Hrs, 0825 Hrs and at 0945 Hrs. Only one bird (presumably the female) was frequently found at the nest. i.e. at 0725 Hr, 0757 Hr, 0758 Hr to 0303 Hr, 0838 Hr,0908 Hr,0910 Hr,0940 Hr, 0944 Hr, 1007 Hr and 1012 Hr.

Both sexes seemed to take interest in nest construction. Both were seen excavating the tunnel. Such sharing of duties were seen between : 0730 Hr and 0740 Hr, 0803 Hr and 0812 Hr,0818 Hr and 0822 Hr, 0850 Hr and 0903 Hr, 0917 Hr and 0920 Hr, 0948 Hr and 0956 Hr. Not all the motor movements of the birds could be seen when the birds were in the tunnel, since the tunnel was dark. But the observations suggest that :

The tunnel is probably excavated with the bill and loose mud is kicked out by the backward movement of the feet. Only once at 0832 Hr did one of the birds come out of the tunnel head first. The time the birds remained in the tunnel varied, but there seemed to be a tendency for the birds to remain for longer periods in the tunnel as nest construction progressed. probably due to the time required for lengthening the tunnel and removing the loosened mud. It may be concluded that courtship feeding certainly takes place in the Small Blue Kingfisher.

Both sexes share nest construction duties, it appeared that the bill is used in excavation, while the feet are used to kick loosened mud from the entrance.

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Avian Nesting and Roosting on Eucalyptus Trees in Punjab

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Roosting and nesting of birds was studied in Eucalyptus teretecornis, one of the dominant and exotic tree species in Punjab,especially on farmlands. Farmers have planted it on the boundaries of fields as well as in blocks. Due to the decline in the availability of indigenous tree species,birds roost and nest on this species. We surveyed the boundary lines and block plantations for studying their use by the bird community. As many as 14 species were recorded using this species for nesting. House crow was found to be the most common nesting species(58.6% of total) followed by Pied Myna (18.9%),Black Drongo (5.1%), and Ring Dove (5.1%).Leaving aside House Crow and Ring Dove all other nesters have useful role to play in Punjab agro ecosystems. Some threatened species viz. Great Horned Owl,Red headed Merlin and Shikra have also been recorded in Eucalyptus plantations in the state. Twenty two bird species have been recorded roosting in Eucalyptus row and block plantations. House crows (56.45%) were the most common followed by Common Myna (24.11%),Rose Ringed Parakeet (10.15%),Pied Myna (6.67%) etc. This tree seems to be preferred by birds because of its height, foliage canopy and ubiquity in the state. Rare and threatened species like Great Horned Owl and Long Eared Owl have also been seen roosting in Eucalyptus block plantations.

Observations on Heart Beat of Whitebacked Vulture, *Gyps bengalensis*

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Two dozen Whitebacked Vultures, *Gyps bengalensis*, caught from Gir forest, Gujarat in May–June 1986 were transferred to Korakendra, Bapane (a carcass processing plant in the suburb of Bombay) and housed in an aviary for different experiments. Here observations were made to find the pulsation of heart in the vultures. Heart beats were recorded with the help of stethoscope directly from the chest. As the vultures were caught wild, they represented different age groups i.e. sub-adult, intermediate and adult. Heart beat may indicate physiological status of the bird.

Heart beat of 24 vultures of different ages was recorded in the months of July, August and December, 1986. It was observed that there was great intraspecies variation (Table 1). The overall heart beat of vultures varied from 70 to 150 heart beat/minute. Among the 24 individuals the average minimum pulse was 99/minute and the maximum was 141/minute. The mean heart beat rate was 123 pulse/minute.

This variation in the heart beat of vultures can be attributed to the following factors :

1) Physical condition of birds
2) Age of birds
3) Sex of birds
4) Movement, while catching the birds
5) Stress, while handling the birds and
6) Fear of human beings

Acknowledgements

This study was sponsored by ARDB, Ministry of Defence, Government of India through BNHS. I thankful to Dr Robert B. Grubh for all the possible help.

Table 1 : Heart Beat of Individual Vulture per minute (Average of three observations)

Bird No	Avg. heart beat	Bird No	Avg. heart beat
1	115	13	120
2	121	14	134
3	115	15	133
4	100	16	133
5	124	17	126
6	123	18	131
7	129	19	108
8	134	20	126
9	107	21	99
10	137	22	131
11	141	24	128
12	114		116
Avg.			123

'Deflighting' Vultures to Reduce Hazards to Aviation

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INTRODUCTION

Vultures and Pariah Kites are responsible for more than 50 per cent strikes to aircrafts in India (Rao, 1982 and Barnwal, 1982). These have led to colossal economic losses every year. These species confer benefits with their efficient scavenging roles (Ali, 1972). However, no study has been attempted in development of a simple technique to 'deflight' vulture without affecting movement and scavenging roles. These aspects under experimental conditions have been investigated.

Material and Methods

Wild Whitebacked Vultures (*Gyps bengalensis*) were caught by 'noose trapping' and acclimatised in cages. Food and water were provided daily in separate pans. In order to deflight them without injuring, a malleable galvanised wire of 0.75 to 1.0 m long and 0.10 mm thick was entwined on primary and secondary wings of both sides without injuring or crushing the bones, but not tight enough to disallow wing flapping. Of 10 deflighted individuals, four were released in a 13.5 × 10.5 walled (2.2 m) court yard and 6 marked individuals were released in their preferred habitat (sanitary landfills at Timarpur, Delhi). Their behaviour was recorded from January 1983 to July 1983. Behaviour of individuals in both locations was compared with the wild birds.

Results and Discussion

Behaviour of 'deflighted' and normal Vultures was somewhat similar (Table 1). The food intake in 'deflighted' vultures was 1.0 kg/24 hrs/individual in captive conditions against 1.0 to 1.5 kg/24 hrs/individual under normal conditions. However, under deflighted conditions, the normal sexual signals (male appeasing, fanning, flapping wings and mounting) were inhibited as male on mounting was unable to balance. These indicated that breeding is hampered on deflighting but not scavenging. Of six deflighted vultures released in Timarpur, Delhi, four marked individuals were sighted after 9 months. From the study deflighting vultures without disturbing utilisations of their scavenging roles is suggested. The enclosure where wastes are dumped should be covered as deflighted vultures may attract other soaring vultures.

Deflighted vultures thus help in reducing aviation hazards without affecting scavenging.

Acknowledgements

Authors are grateful to late Dr R.A. Agarwal, former Head of the Entomology Division, IARI, New Delhi, other authorities of IARI and the Aeronautical Research and Development Board, New Delhi, for facilities.

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Table 1 : Comparative behaviour of deflighted and wild Whitebacked Vulture

Behaviour		Behaviour of Whitebacked Vulture	
		Caged	
		Normal individual	Deflighted Vulture
I			
a	Courtship	Not noticed	Abrupt , incomplete
b	Feeding	Neck bending, shearing and tearing, gulping	Neck stretching, picking meat pieces, shearing & tearing, gulping
c	Feeding potential* per 24 hr	1.0 kg	1.0 kg
d	Intraspecific behaviour	No interaction	Quite aggressive upto 3–4 days after deflighting, l afterwards no alteration
e	Allopreening	Occasional	Frequent
II		Wild individual	Deflighted individual
a	Power of flight	Maintained	Lost
b	Response to human proximity	Remains stationary	Runs away
c	Intraspecific behaviour	Interchanging and overlapping	At fringes mostly
d	Locomotion	Flying, walking	Running, leaping, hopping and walking

*1.0 kg buffalo meat was offered daily to birds in trays (45 × 30 × 15 cm). Average meat consumption (n = 20) by caged and deflighted vultures are 583.63 g and 615.50 g by dry weight. 't' at 1 df = ($P < 0.05$).

Serum LDH Isozyme Analysis of Some Birds Infected with Plasmodium

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Introduction

Fowls and pigeons are birds that are domesticated. *Plasmodium gallinaceum* in the fowls and *Plasmodium pinottii* in pigeons are quite common infections of our region. In recent years biochemical methods have proved to be of considerable value in differentiating genetically distinct groups of malarial parasites. As there is a direct relationship between genes and enzymes variations in enzymes directed by these methods always reflect gene differences. Enzyme studies in both mammalian and bird malarial parasites have shown a high degree of genetic polymorphism. Several enzymes have been studied electrophoretically in malarial parasites and LDH found to be of particular practical value.

Material and Methods

Experimental chicks were injected with 0.5 ml of blood each, from naturally infected hosts with *Plasmodium gallinaceum* and *Plasmodium pinottii*. Blood was collected from the infected chicks at heavy parasitemia (24/100). At the same time blood from normal chicks was also collected. Serum was separated and kept at -20°C until needed. Sodium azide was used as preservative. 0.1 ml of serum from both normal and infected chiks was incorporated in the sample gel. Disc electrophoresis was carried out using acrylamide gel at a running pH of 8.9. The current was 5 m Amp per tube (each column) and the duration of the run was 90 min. LDH bands were visible in the gels after incubating in dark at 37°C for 60 minutes in reagent mixture containing NAD, Sodium Lactate, NaCl, $MgCl_2$, PMS, Nitrozolium blue and Phosphate buffer of pH 7.4. The samples were photographed.

Results and Discussion

The LDH isozyme band pattern of the normal chick serum and infected chick serum was analysed. Of the 4 bands appeared in the normal chick serum, the fast migrating band which corresponds to LDH-4 was lacking in the infected chick serum. Bands LDH-2 and 3 were lightly stained, whereas LDH-1 was similar in both the cases (Figures 1,b and c). This indicated that light stains of LDH-2 and 3 were due to parasitic infection. Since the chicks were normal the only source of changed isozyme band pattern seems to be due to plasmodium infection. In case of *Plasmodium pinottii* LDH-1 band was similar to that in normal chick serum, LDH-4 was lightly stained, LDH-2 and 3 bands were not to formed (Figures1, a and b).

The Rf values of bands in gel (b) from bottom to top are 5.9, 4.9, 3.7, 2.4 and 1.1 cm. 5.9 cms migrated band is fast migrating and 1.1 slow migrating. Similarly in gel (a) 6.2 cm (bottom one) is fast migrating and 1.1 cm slow migrating.

The variation in LDH isozyme band pattern showed that the infected serum lacked LDH-4 isozyme band and the bands 2 & 3 were lightly stained due to the infection of Plasmodium spp. This indicated that the decrease in the number of bands were due to plasmodium infection.

The LDH isozyme band pattern showed variation in chick seras of *Plasmodium gallinaceum* and *P.pinottii*. This appears to be due to species specificity of Plasmodium infection.

Plasmodium contains the LDH if its own, so the change in the infected sera differs from species to species. It may be due to change at the level of the gene transcription.

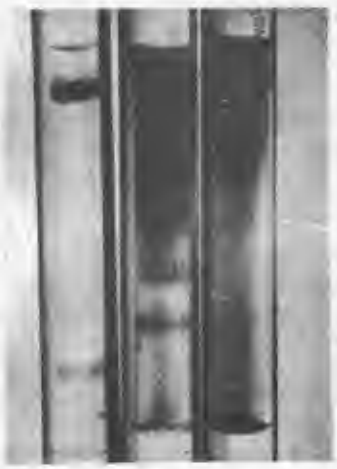

Fig.1 . LDH isozyme patterns of Chick Seras
a) Chick serum infected with *P.pinottii*, b) Normal Chick serum, c) Chick serum infected with *P.gallinaceum*.

Effect of Dexomethazone on the Immune Responses of Bird Malaria

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Introduction

The Avian Malaria is found in every continent and probably every country of the world. *Plasmodium gallinaceum* many species of Malaria have been described from birds although there are only few species generally accepted. An important parasite of the domestic hen was probably first seen at Natrang in Indochina, and is used in the study of avian immunity.

Immunity may be suppressed through several ways and steroids is one of them. The effect of steroid hormones to infection and immunity have been reviewed by Applegate (1970).

The present work revealed the effect of Dexomethazone on the course of infection, alteration in the immune system and the presence of the specific antibodies.

Material and Methods

The bird malaria species *P.gallinaceum* was collected from the natural host fowl *Gallus gallus* near Kakatiya University in Warangal. It was maintained in leghorn chicks for the experimental study. The chicks were brought to laboratory in batch wise, vaccinated and protected from mosquito bite by using mosquito mesh. One week old chicks were provided with 25 watts bulb in the cage to maintain suitable temperature.

For raising the antisera, rabbits were maintained in the laboratory for about one week before starting the experiment. Two doses of antigen were given to rabbits in Fraud's adjuvent at one week interval and after a week antiserum was collected. In the course of experimentation due importance was given to sterilization of instruments.

The blood was extracted from the peripheral vein of the natural host wing. It was collected into sterilized tubes with sodium citrate and was injected into the experiment chicks intravenously or intramuscularly. The quantity of blood was 0.2 ml to 0.5 ml.

Two age groups of one week and 4 week old chicks were taken for the present study. Dexomethazone Sodium Phosphate 4 mg in 2 ml was supplied by the Schering corporation. The chicks were given 0.5 ml of Dexomethazone daily in 6 doses prior to the inoculation of the parasite. The quantity of infected blood inoculated was 0.5 ml. The control chicks were given only *P.gallinaceum* without any drug. All the chicks were examined daily for the presence of plasmodium by withdrawing a drop of blood from the nail and smears were made and fixed in methyl alcohol and stained with Giesma's stain. The infected chick sera were collected and analysed for the specific malarian antibodies by ouchterlony and immunoelectrophoresis.

Passive protection was assessed by injecting drug treated infected sera to the chicks prior to inoculation of the infected blood. The control chicks were given only the infected blood.

Antidiotype sera were raised to find out the specific antibodies for infection, treated with Dexomethasone. To raise the antidiotype sera, the chicks were inoculated with Dexomethazone infected chick sera and *P.gallinaceum* antigen. The quantity of serum taken was 0.25 ml of infected sera and 0.25 ml of antigen. After a week when there was infection, the sera were collected.

Results and Discussion

In Dexomethazone treated one week old chick the infection appeared one day earlier than the control chicks. In Dexomethazone treated 4 week old chick the infection appeared similar to the control but the degree of parasitemia was more than the control. The infection gradually increased till 10th day and later gradually decreased in both control and treated chicks, but in treated chicks there was a sudden rise in infection on the 14th day and died on 18th, while in control it gradually decreased and disappeared on 20th day (Figure 1).

In the passive transfer of protection, when normal sera were given the course of infection was similar to the control. In infected sera given chicks the infection appeared 2 days later, while in Dexomethazone treated infected sera treated chicks the infection appeared 9 days later than the control and only ring stages were observed. Infection disappeared on 15th day but reappeared after one week (Figure 2). The young birds exhibited recognisable level of parasitemia more readily than the older birds. It is presumed that this is a common phenomenon with malaria infection, irrespective of the species.

Steroids are potent immuno-suppressive agents and act in several ways like reducing circulating lymphocytes, destroying thymus cells, inhibiting the uptake and processing of antigen and acting as anti complementary (Edward, 1970).

The results of chicks treated with corticosteriods infected with plasmodium show interference in the intensity of infection reported by Schmitt *et al.*, (1951). Redmond (1963) reported the influence of corticosterone on the natural course of malaria in the pigeon. The present results agree with Redmond that the level of parasitemia was higher than the control. Applegate (1970) and Hawking (1975) demonstrated the allocation of circulating parasites of *P.relictum* from *Trypanosoma congolense* more than the control. High dose of Dexomethazone to cerebral malarial patients caused death, Warrel *et al.*, (1982). If the degree

of parasitemia increased, pre-patent period reduced and the birds died of infection. The humoral immunity was partially impaired as noted in ouchterlony and immuno-electrophoresis test.

Cohen *et al.*, (1971) reported that passive immunization with *P.falciparum* immune sera has the parasite neutralising capacity in *in vivo*. In the present study also the drug treated sera had the neutralising capacity. So, the degree of parasitemia could be reduced and the bird could survive. Birgitta Wahlin *et al.*, (1990) showed the effect of antiidiotype antibodies on the antiparasitic response. They stated that long lasting high titre antibody response will be obtained with these immunogens. In the present study also the high titred antibodies were noted and the results were similar to the antigen. From this we can conclude that though Dexomethazone is an immunosupressive drug and allows the increase of parasitemia the antiidiotype sera of these can be used for antiparasitic response as the antiidiotypes exhibit the internal image of the antigen.

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Table 1: Results of the immunodiffusion test conducted in the present experiments

By Immunoelectrophoresis

1)	a)	Infected sera	—	IgA
2)	b)	*P.gallinaceum* Antigen	—	IgG, IgA and IgM
3)		Dexomethazone treated chick sera	—	No bands
4)	a)	Dexomethazone infected sera treated chick sera (Antiidiotype) Antisera	—	IgA, IgM, IgG

By Ouchterlony

		Sample in the peripheral wells	*Centre well*	*No. of bands*
1)	a)	Infected chick Antigen	Antisera	4
	b)	Infected fowl sera	Antisera	–
	c)	Dexomethazone drug treated chicks sera	Antisera	2
	d)	Infected chick sera	Antisera	–
2)	a)	Normal chick sera	Antisera	–
	b)	Dexamaethazone drug treated chick sera	Antisera	2
	c)	Infected chick sea	Antisera	–
	d)	Dexomethazone treated infected chick sera	Antisera	3
3)	b)	Antisera treated chick sera	Antisera	–
	c)	Dexomethazone infected sera treated chick sera (Antiidiotype)	Antisera	4
	e)	Infected fowl sera	Antisera	–

Table 2: To find out the specific antibodies the antisera were tested against different sera by immunodiffusion-ouchterlony and immunoelectrophoresis and the following results were noted.

In immunodiffusion ouchterlony test

Sl. No	Samples in the peripheral wells	Sample in the central well	No. of bands
1.	Normal sera	Antisera	–
2.	Infected sera	Antisera	1
3.	Dexomethazone treated infected sera	Antisera	2
4.	Antiidiotype sera	Antisera	3
5.	Antigen	Antisera	4

Immunoelectrophoresis test

Sl. No.	Test sample	Sample in the trough	Bands
1.	Normal sera	Antisera	–
2.	Infected sera	Antisera	IgA
3.	Dexomethazone treated inffected sera	Antisera	IgA, IgM
4.	Antiidiotype sera	Antisera	IgA, IgM + IgG
5.	Antigen	Antisera	IgA, IgM + IgG

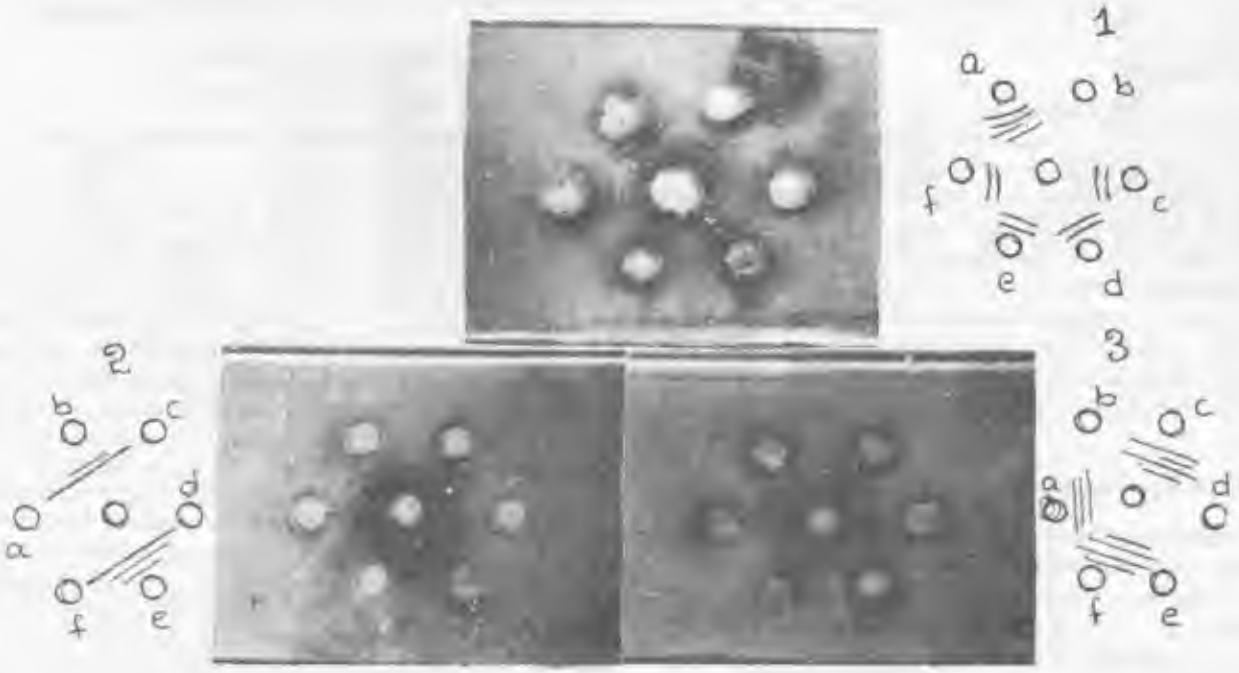
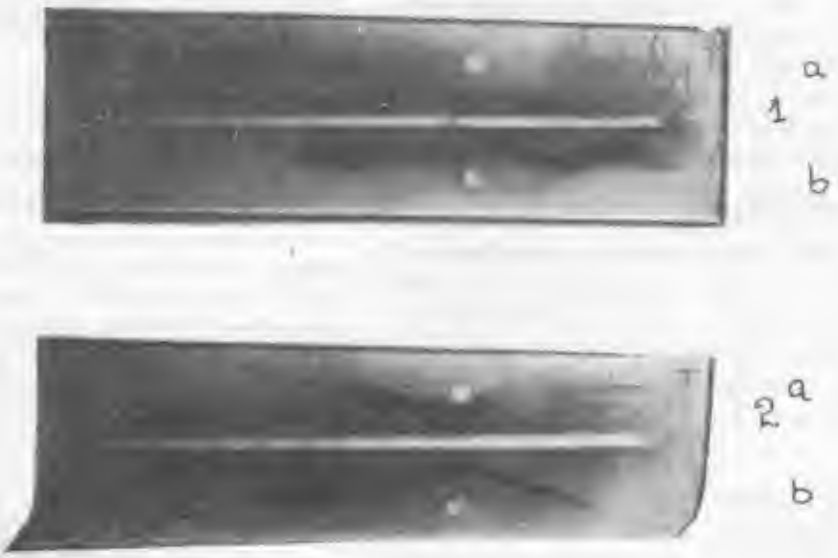


Fig.1. Effect of dexamethazone on the immune response to *Plasmodium gallinaceum*



Monogamy in Ashywren Warbler *Prinia Socialis* : How Much do Sexes Share Domestic Duties

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Introduction

In a typical monogamous mating system, both sexes are expected to share domestic duties (Oring; 1982) viz. nest building,incubation, brooding and nestling care. Among Indian monogamous bird species (Ali & Ripley; 1987), it is not clear to what extent this pattern prevails. The Ashy Wren Warbler *Prinia socialis* (Sykes) is a monogamous species wherein male and the female of the breeding pair are known to share all domestic duties viz. defence of territory, nest building,incubation,breeding and nestling feeding equally (Ali & Ripley; 1987). In this paper the role of sexes in Ashy Wren Warbler is examined.

Material and Methods

Observations were made on nesting *P. socialis* in Bangalore during 1988, to 1990 breeding seasons. In these years, a typical dome shaped nest with side entrance (Ali & Ripley; 1987) were built in a clump of *Barlaria sp.* All observations were made from a nearby window of the house which afforded a clear view of the surroundings without disturbing the nesting pair. During 1990, observations were made from dawn to dusk while during 1988 and 1989 observations were made with pauses. It was not possible to collect data on the nest building habits of the species. However, extensive observations were made on the incubation,brooding and nestling feeding. Details were also collected on all activities of each sex. Although the sexes are alike in the species, the parents show plumage differences. The parents were sexed based on mating and egg laying. To facilitate proper identification of sexes, a branched dry twig was planted in front of the bush in which the nest was placed. This gave an additional time to observe the birds which visited the nest.The birds used this perch with a fair amount of regularity thereby affording an opportunity to correctly identify the sexes.

Results and Discussion

In a typical monogamous mating system both the male and female are expected to share domestic duties equally (Oring; 1982). The observations made on the nesting activities of *P.socialis* revealed a situation quite contrary to this. Both intra-specific and inter-specific intruders were chased by *P. socialis* pair which were being observed. Though both the sexes were involved in territorial defence, the extent of their involvement in domestic duties showed variations. Based on the extent of their involvement this activity was classified into :

i) male alone chasing the intruder

ii) female alone chasing the intruder

iii) chase initiated by male and followed by female

iv) chase initiated by female and followed by male

v) chases made simultaneously by male and female

When the territorial defence chases made during the entire nesting period was analysed, it was found that the chases initiated by both the sexes together was the most common compared to other categories. However, when the territorial defence chases made by the nesting pair during the incubation and nestling periods was analysed separately the female showed greater involvement than the male (Fig. 1). However the extent of involvement by each sex was not significant during the nestling period. Also,there was no significant difference between the chases initiated during incubation and nestling periods by female alone and those undertaken together. Incubation and brooding was totally a female activity. Though nestling feeding was shared by both the sexes the number of visits made by the female to feed the nestlings were significantly than that of male (Fig. 2). When all the activities were considered together (Table 1), it was found that female had significantly greater involvement than the male. Thus observations indicate that sexes in a monogamous pair may not always share all domestic duties equally. Considering this, in a monogamous mating system the extent of involvement of each sex can fall into the following categories :

a) domestic duties shared equally by both male and female

b) domestic duties where male has a greater share

c) domestic duties where female has a greater share

Ali & Ripley (1987) consider a large number of bird species. in India to be monogamous. It is not known,how many of these species fall into each of the above three categories. In addition to delineating the species with the above three categories, it is worth investigating the possible factors, Viz. environmental, resource availability (food), biological (predation, intruders, etc.) or others, which shape such variations in a monogamous mating system.

Acknowledgements

I thank Dr.S.Subramanya for all the help, constant support and encouragement.

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Fig. 1 Pattern of territorial defence chases made by P. socialis pair.

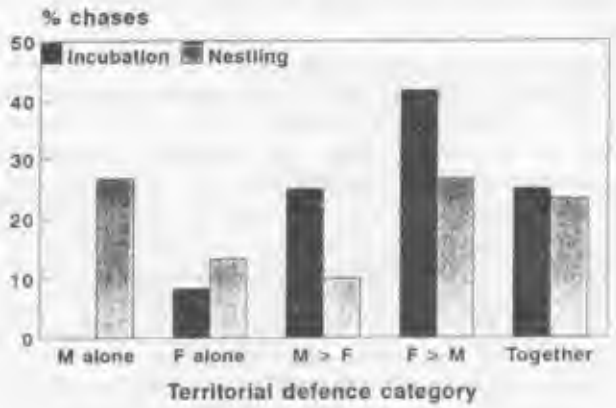
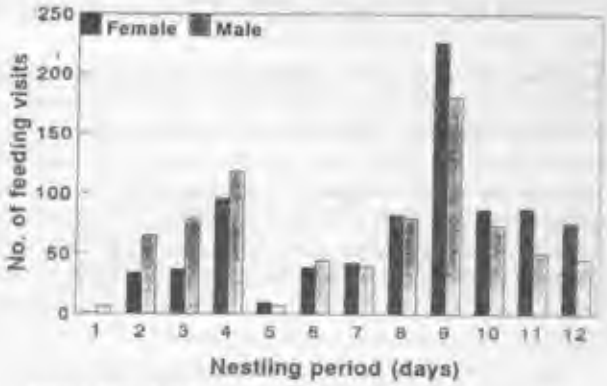


Fig. 2. Nestling feeding by P. socialis pair during nesting



Total visits: F = 821; M = 792

Table 1 : Summary of the extent of involvement of different sexes of *P. socialis*.

Activity	Extent of involvement (%)	
	Male	Female
Territoriality		
a) during incubation period*	25.00	50.00
b) during nesting period*	36.70	40.00
Incubation	00.00	100.00
Brooding	00.00	100.00
Feeding nestlings	49.10	50.90
Index of involvement **	210.18	340.90

* Territorial chases initiated by both sexes simultaneously (i.e. together) has not been considered for this analysis.

** Sum of values of all activities.

Physiological Timing of Seasonal Events in a Finch Spotted Munia

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Successful survival of a species is a measure of its ability to breed at the time of the year when environmental conditions are most conductive for the laying female and the growth of the young ones. Seasonality in birds involves not only the synchronization of breding with the external environment but also with other physiological events like moulting and migration etc., to avoid competing high energetic and nutrition requirements in the annual budget of bird. It is later aspect that we address in the present paper.

The role of thyroid gland in moulting, breeding and calorigenesis is well established in birds. Experiments were now conducted to assess the relative importance of thyroxine (T4) and tri- iodothyronine (T3) in the seasonal context in a sedentary bird spotted munia Lonchura punctulata. Comparative effects of equimolar doses of T4 and T3 in arthyroid birds indicated that T4 is more effective than T3 in inducing moult, fat-mobilisation & gonadal regression. The gonado-inhibitory, fat-mobilising and moult-inducing effects of thyroid hormones are reflected in circulating T4 profile but not T3. Further, effect of suppression of extrathyroidal conversion of T4 to T3 suggest that a seasonal variation in peripheral conversion of T4, in accordance with the demands of the season may determine the expression or inhibition of a particular thyroid-dependent seasonal events e.g. breeding, fattening or moulting. This may be a physiological strategy used by birds to preclude simultaneous occurance of seasonal events.

A Study of Whitebacked Vulture, *Gyps Bengalensis*, in Relation to Permanent Feeding Ground of Vanasthalipuram, Hyderabad (A.P.)

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Introduction

The Vanasthalipuram garbage dump-cum-compost plant of municipal corporation of Hyderabad was found to be the major feeding ground for the vultures. In addition, White Scavenger Vultures, Pariah Kites, crows and egrets were found here. This area is situated on Hyderabad-Vijayawada road nearly 10 km from the main city and nearly 15 km southeast of Hyderabad aerodrome. Apart from vegetarian and non-vegetarian waste from city (eating and slaughter houses) the municipal staff bring carcasses of domestic animals for skinning and manure. The leftover meatwaste provides dependable food source to the vultures. Hence, they visit the place regularly.

Materials and Methods

A survey of Whitebacked Vultures was carried out around Hyderabad in two sessions. The first session lasted for twelve weeks, from October 1984 to January 1985 and the second for nine weeks, from June to August, 1985.

Two full day spot study was conducted in each session besides other visits. As many as 3000 vultures have been counted here at a time and 500-600 vultures could be seen in any casual visit.

Results and Discussion

Pattern of arrival of vultures to the dumping ground

Congregation of vultures started to this place before 0600 hrs from south, east and north. Birds arrived in low flights and sat in groups on the ground. The maximum number arrived between 0930 hr and 10 00 hr. After 10 00 hr the number of vultures remained fairly constant till departure.

Pattern of departure of vultures from the dumping ground

It was observed that the departure of vultures started after 1600 hr to the same direction from where they came to the respective roosting sites by soaring in thermals first and then gradually by low flight. Departure was over only by complete dusk.

Feeding behaviour of vultures on the dumping ground

It was observed that the vultures were eating throughout the day but certainly following the leader. Leadership used to be taken by the adult only. Kruuk (1967) found differences in the order of arrival at carcasses and dominance hierarchies among members of scavenging guilds. Similar observation has made by Atwell (1953), Petrides (1959), Houston (1973), Grubh (1974) and Mundy (1982). Apart from leadership, extent of hunger was played an important role. It was found that vultures ate at intervals due to interference from the workers and to rotate feeding among new comers. Clinton Eletniear (1981) and Vernon and Piper (1984) found human activity and effect of food supply to be the factors affecting the feeding of vultures at carcasses. It was also observed that vultures used to visit the permanent feeding ground even if there was no food available to them. Vultures at this permanent feeding ground were found till late evening. Torboton (1981) opined that vultures could congregate in areas where carcasses supply was sustained. On the carcasses vigorous intraspecific competition was observed and the frightening call/hissing and aggressive posture were very much in use apart from walking, flapping and neck movement.

It is concluded that the congregation of vultures at the permanent feeding ground of Vanasthalipuram start early in the morning (even before 06 00 hrs) and remain throughout the day. The maximum concentration reached by 09 30 hrs to 10 00 hrs and remained fairly constant till 16 00 hrs. Birds disappear from the feeding ground after 16 00 hrs either in thermals or by low flight in the same direction from where they came in the morning. The slightest disturbance from workers keep the vultures away from the food. Vultures have to forage throughout he day, because of disturbance from workers, intraspecific competition, and hunger.

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ECONOMIC ORNITHOLOGY

Insectivorous Birds and Their Use as Biological Control Agents

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Introduction

Birds and insects have one thing in common: the ability to fly. This has enabled the former to overlap the ranges of the latter and limit their population build-up. The harm birds do, bird- lovers claim, are shouted from roof-tops, but, the good they do go often un-noticed. A claim not without any basis, especially in India. For, as early as 1912, Mason and Lefroy, had clearly brought out the beneficial roles of several insectivorous birds, but they remained in print, while the publication, to date, remains out of print. (to the best of my knowledge)!

Mason and Lefroy's (1912) book, published as a memoir of the department of Agriculture (entomological series), comprising 371 pages, has clearly brought out the status of Indian birds vis-a-vis harmful-neutral-beneficial status. If, Indian thinking emerges in the direction of using birds as 'biocontrol' agents, then Mason and Lefroy's contribution would serve as the foundation, for, not only it is the first monograph on the theme, but also the only elaborate treatise on food of Indian birds.

The question that naturally arises is that why birds have not received consideration in India as a biological control agent as it has, for example, received in China (Zhang, 1992). Some of the reasons could be as follows :

One : Biological control has been the subject of entomologists, and by natural enemies, emphasis has been given to insect predators and parasites and pathogenic microorganisms.

Two: By 'Control' the erroneous impression that has been generated in India is to mass rear and release. As birds are not easily amenable to mass rearing, they have not been thought of as ideal candidates in biological control programmes.

Three: Lack of knowledge of birds among pest managers and vice versa; ornithologists rarely have knowledge in the intricacies of pest management.

Four: A pervasive lack of environmental consciousness.

A lack of vision, in regarding and encouraging birds in agro- ecosystems is evident even in the project reports of the All India Coordinated Project on Economic Ornithology (Anon, 1980–1988), as more emphasis here, has always been on bird pestilence. Besides, other pest management programmes fall short of appreciating the correct roles played by birds, except for casual mentions, many a times merely as woodpeckers or swallows, without even mentioning the species name completely, let alone the scientific name.

This preamble, discursive and with a dismal tenor, is not meant to project a gloomy outlook, but to, hopefully, muster resolve to go ahead optimistically. Nevertheless, it is not without paradox, that the first biological control introduction was from India and that too a bird, the Myna, *Acridotheres tristis* L. This bird was sent to Mauritius in 1762 to control the red locust on sugarcane (*Nomadacris septemfasciata* Serville), which it effectively did in about 8 years time (Coppel and Mertins, 1977). That majority of our numerous acridids and related orthopterans are not assuming pest statuses, is largely due to birds, has been well demonstrated in stomach analyses of several Indian birds (Mason and Lefroy, 1912). Still, it has failed to catch the eye of pest management visionaries.

Material and Methods

Literature from beginning of this century, from India and other countries was purused, analysed and reviewed. Suggestions, based on the review, have been included.

Results and Discussion

Insect predation by birds — The genesis of scientific study in other parts of the world

Germany

In Europe and Russia, by the fifties, the role played by birds as insect predators, especially in forest ecosystems was clearly visualized (Bruns, 1959). The lead was provided by Germany. Ornithologists here intensified research, which helped accurately determining the insect prey types of different species of birds. They also developed artificial nestling mimics to allow specific prey identifications. Further, they standardized neck-ringing methods on fledgling to preserve fed insects intact and procedures to analyze regurgitated food of nestlings (Bruns, 1955, 1957; Franz, 1954,1967). According to Bruns (1957) the major studies were in the insect genera *Dasychira, Bupalis, Panolis, Diprion* and *Lygaeonematus.*

England

In England by late fifties, the inter-relations between birds and insects were studied in detail by Gibb (1960). He found that wintering birds removed nearly 50% of the insect population. Birds responded to the prey insects both functionally and numerically.

Holland

The famous ornithologist Tinbergen(1960) known more for his pursuits in bird ethology, laid the scientific foundation for studyies on insectivory in birds. His study in 1960 showed the importance of recording the frequency of prey in bird diet rather than the proportion. The concept of "search image" was enunciated by him through his studies on birds.

China

China seems to have adopted birds as biological control agent as early as the 16th century, when domestic ducks (*Anas platyrhynchos* L) were mass released into paddy fields for locust control. This is recorded in *A Legacy of Locust Control* edited by Shri Yuan Chen (1736–96 AD). Modern interest in birds as biocontrol agents started in the fifties (Zhang, 1992). Their most beneficial birds include *Parus major, Cyanopica cyana, Dendrocopos major* and *Sturnus roseus*, besides, there are atleast 26 other recognized insectivorous birds. Currently, bird augmentation is by conservation through reduced pesticide use, artificial nests and mass release of domestic ducks (Zhang, 1992).

Russia

In the early sixties, field studies were conducted using portable shelters or hides, notably by Khavatova (1960) and Poznanin (1960). Their studies independently carried out, showed that birds suppress many noxious insects and by enhancing nesting conditions birds can be encouraged in agro-ecosystems.

USA

Upto the middle of 20th century, insect suppression in birds was evidenced only by stomach analysis. But after that, elaborate field investigations stimulated interest in encouraging birds in agro- and forest ecosystems. Some important workers of the fifties and sixties were: Knight (1958) on bark beetle predation by woodpeckers; Stewart and Aldrich (1951) on spruce budworm predation by Paridae; Coppel and Sloan (1971) on predation of larch casebearer *Coleophora laricella* (Hubner) and pine sawfly (*Diprion similis* (Hartig) by resident and wintering birds; and Whitecomb (1971) on predation of pecan nut basebearer (*Acrotasis caryae*) by tufted titmouse (*Parus bicolor*). All these served to lay a strong base for furthering studies in this aspect of economic ornithology. Further, the review of Buckner (1966, 1967) served to highlight the importance of bird predators in suppression of insects in forest ecosystems.

These are some of the relevant literature which show how scientific study on the theme started in different parts of the world.

Birds as insect predators — Indian Scenario

Verghese and Subramanya (1985) emphasized on the relevance of the subject and thought they had set the ball rolling towards meaningful application of birds as insect suppressers in our agro-ecosystems. Realization seemed to have dawned among the august audience gathered, but to put it succinctly, the subject is yet to launch in its own rights.

Gleaning through Indian ornithological literature, a conspicuous neglect of this area of economic ornithology is evident, in spite of the good start it received as mentioned earlier in 1912. The *Journal of the Bombay Natural History Society*, the premier journal devoted to ornithology reveals a sketchy approach to this subject which is reviewed and presented below.

The first report on insect predation was by Aitkin (1904) of Bee- eaters (*Merops orientalis*) preying on *Danius* sp. and the King Crow (*Dicrurus adsimilis*) preying on *Euthalia garuda*. The next specific mention seems to be that of Krishnaswamy and Chowhan (1956) who reported that the Goldenbacked Woodpecker (*Dinopium benghalense*) and the Maharatta Woodpecker (*Dendrocopos mahrattensis* fed well on the termite *Odontotermus obesus*. From Rajasthan, Singh and Singh (1960) reported that the Adjutant Stork (*Leptopilos dubius*) as a destroyer of locusts. He also mentioned of Bulbuls (*Pycnonotus* spp.), Pitta (*Pitta brachyura*) and Common Myna (*Acridotheres tristis*) preying on ants like *Solenopsis geminata, Camponotus compressus*, etc. Sharma (1964) found the Painted Patridges (*Francolinus pictus*) preying on the ant, *Monomorium indicum*. In a stomach analysses on the same bird, David (1965) found termites, rodents and caterpillars to be important dietary constituents. Between 1971–75, Mukerjee in an elaborate study in the Sunderbans of West Bengal found from stomach analyses, that Cattle Egret (*Bubulcus ibis*), Whitebreasted Kingfisher (*Halcyon smyrnensis*) and Redwattled Lapwing (*Vanellus indicus*) to be very beneficial, as majority of their food items were injurious insects. Toor and Ramzan (1978) reported *Motacilla caspica* as a predator on the aphid, *Lipaphis erysimi* Kalt. In the same year, Chakravarthy and Lingappa, reported Wagtails as predators of field bean aphids.

Insectivorous birds in and around Bangalore (Verghese and Subramanya, 1985; Chakravarthy, 1988; Verghese, 1992).

These are based on studies conducted by the above authors.

Ashy Wren-warbler, Prinia socialis

This bird has been reported an effective predator of *Aphis gossypii* in guava and cotton ecosystems. In guava, it negatives the growth rate (*r*) of the aphid by August.

Common Bee-eater, Merops orientalis

Though a sallying feeder, it does pick *Aphis craccivora* infesting cowpea. The adult pierid (*Pieris brassicae*) is hawked in flight.

Black Drougo, Dicrurus adsimilis

Feeds on winged termites, and dragonflies especially prior to roosting. In dolichos fields, feeds on exposed

larvae of the pod borer *Helicoverpa armigera* @ 3.9 ± .18 larvae/minute.

Golden Oriole, Oriolus oriolus

Feeds on *H.armigera* infesting dolichos pods @ 3.8 ± 0.6 larvae/minute. The oriole also preys on the hairy caterpillar, *Diacrisia obliqua*. Between resting bouts in casuarina groves, the bird descended to fields with mixed stand of sorghum + field bean. During active feeding, the bird used to consume 2 caterpillars every three minutes.

Hoopoe, Upupa epops

Like the oriole, the bird descended from casuarina grove to feed on *Diacrisia obliqua* @ one caterpillar per three minutes.

House Sparrow, Passer domesticus

Though a granivorous bird, it has been observed occasionally preying on *H.armigera* @ 2.5 ± 0.5 larvae/minute in field bean.

Indian Myna, Acridotheres tristis

Under Bangalore conditions, the bird has been reported on *Helicoverpa armigera* in *Lablab niger* (field bean) @ 2.9 ± 0.17 larvae/minute.

House Crow, Corvus splendens

The crows were the most important predators of the borer, *Adisura atkinsoni* in mixed stands of field bean. Predation was enhanced if trees were available nearby for resting. The birds plucked infested pods, took it away, then split it open and fed 4 ± 0.19 larvae per minute.

Jungle Crow, C.macrorhynchos

On the outskirts of Bangalore, follows plough or tractors, and feeds on exposed grubs of *Holotrichia* spp. and pupating larvae of *Spodoptera litura*.

Wagtails, Motacilla spp.

These have been seen actively preying on the aphids, *Aphis craccivora* in field bean and *Brevicoryne brassicae* in cabbage. The wagtails have been reported as a predator on the diamond back moth, *Plutella maculipennis* in cabbage by Jayarathnam, 1978.

Emitic analysis on Indian Wren-Warbler

Emitic analysis on the fledgelings of the Indian Wren-Warbler (*Prinia subflava*) in a ragi (*Eleusine coracana*) ecosystem in Bangalore have shown the following dietary proportion (2).

Trichoplusia signata	64.10,
Helicoverpa armigera	12.82,
Cacaccea micasiana	5.13,
Odontotermus sp	2.56,
Acridids	2.56
and Unidentified	12.82

The above, clearly showed that more than 80% of the diet consisted of injurious insects.

All the above examples have been recorded in studies in the last decade or so, thereby, reviving a thrust, which was earlier neglected. Hopefully, with the current increased awareness in environment and conservation, the role of insectivorous birds may be better appreciated by scientists and laymen.

Management of insectivorous birds

Management here implies the conservation, as well as agumentation of bird numbers by broadening their niches. Birds can thus be manipulated to serve an important function in agro-ecosystems viz., insect pest reduction. This will serve to reduce dependence on insecticides.

Suggestions to augment/manage insectivorous birds and future line of work

1. Provision for nesting sites. According to Bruns (1955), nesting space was a more critical factor than food supply. He later (1959) concluded that any effort to increase bird density was not wasted. He showed that it was possible to increase the local bird population through saturation of area with nesting boxes. Franz (1961) experimentally showed that wherever birds were augmented by use of nest-boxes, the outbreak of pests did not appear or were at low densities.

   Nest attraction has not been intensive in N. America, as compared to Europe. However, experiments with chickadee, *Parus gambeli* Ridgeway, using nest boxes in California, showed that infestation of lodgepole pine needleminers of the genus *Recurvaria* substantially decreased (Dahlsten and Herman, 1965).

2. Introduction of highly adaptive insectivorous birds to newer areas

   The best example, is that of the Indian Myna to Mauritius in 1762. Likewise resident birds can be transferred to areas where proportion of insectivorous birds are low. Here data on regional bird surveys are vital.

3. Providing resting niches

   Agroecosystems interspersed with trees have relatively more proportion of bird species, and consequently insectivorous birds (Coppel and Mertins, 1977). Planting of tall trees on edges, not only serve as Windbreaks, but encourage floral and faunal diversity. Trees will be used by birds as resting perches to issue into field at their convenience, a fact, reported first by Barber in 1942, and subsequently confirmed by several others.

4. Use of multicropping, as opposed to monocropping favours not only bird predators but also other parasitoids.

5. Planting stakes in the field can serve as useful perches. e.g. for the Drongo, *Dicrurus adsimilis* and Shrikes, *Lanius* spp. Thorny bushes, even sparsely distributed in agroecosystems serve as stakes. It is especially liked by the Shrikes for impailing their prey (Ali and Ripley, 1983).

6. Electric poles and wires in a non-grain ecosystems are again useful in attracting birds like Roller (*Coracias bengalensis*) Whitebreasted Kingfisher (*Halcyon smyrnensis*), Common Bee-eater, *Merops orientalis*, Swallows *Hirundo* spp. etc.

7. Planting broad-leaved bushes like *Acalypha* in horticultural ecosystems encourage insectivores like Wren-Warblers (*Prinia* spp.).

8. Providing of water-troughs, attract ground insectivores like Wagtails, *Motacilla* spp.

In India there is an imperative need to shift biological-control outlook from the existing narrow spectrum of predators and parasitoids to a broader spectrum encompassing the food web in an ecosystem. Biological control, in other words, should shift to a holistic approach, as the entire range of ecological biota and in turn their interaction with physical variables, must be taken into account. Naturally, birds are an important component in this context, especially in a food web. Harnessing and augmenting their potential as insect-eaters, would certainly be in the interest of man, and justifiably a healthy approach to eco- friendly insect pest management. The usefulness of insectivorous birds was realized in the beginning of this century (1912). The scenario remained stagnant with occasional reports. The seventies and eighties, saw a spurt in the study of insectivory in birds, probably influenced by studies in the West. This scenario if sustained will augur well in the overall integrated pest management in India.

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Role of Visual Scarers in the Management of Bird Pests in Agriculture

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Introduction

Majority of the bird pests belong to Passeriformes inflicting damage to cereals, pod stages of several pulses and groundnut, grain stages of sunflower, leaf formation and mature stages of vegetables as well ripe fruits of several types with the losses ranging from 0.5 to 44% in India (Anon, 1982–1987). The role of visual scaring in bird management is herein discussed.

Material and Methods

An attempt has been made to review the visual scaring techniques, based on available literatures.

Results and Discussion

Scarers induce fright by auditory and visual stimuli. The visual scarers used, to deter birds from crop fields are based on response to either novelty or to alarm stimulii elicited in pest birds by predators, both avian and human.

Novelty Based Visual Scarers

These are based on stimulii not experienced by birds and thus depend on novelty of the scarer to produce alarming effects. The pest bird's for that matter any animal's response to novelty is either approach and exploration or flight. This behaviour is explained by postulating that animals assimilate sensory input into a cognitive map (Tolman, 1948) or map (Sokolov, 1963) of their environment. The perceived stimulii prime the animal to expect certain sensory inputs in the near or distant future. The animal compares the incoming sensory input with the expected input. If there is a discrepancy (i.e. novelty), depending on the degree of discrepancy, the animal either approaches (lesser degree of deviation from the expected) or withdraws (if the degree of deviation is too large). To scare birds effectively the properties which elicit withdrawal have to be enhanced and diminish those factors which evoke approach and exploration. Scarers based on novelty have unusual visual patterns and bright colours. These include flags, windmills, reflector ribbons, balloons, eye spot balloons and kites suspended in air. Reflector ribbons were found to reduce damage by Brownheaded Cowbirds in millet fields, by Redwinged Blackbirds in millet, sunflower and corn fields but could not prevent feeding of Goldfinches and Mourning Doves (Dolbeer *et al.*, 1986). Preliminary trials in Bangladesh, India, Philippines and United States of America indicated that reflector ribbons reduce bird damage to corn, millet, sorghum and sunflower (Bruggers *et al.*, 1986). A later study revealed that they were ineffective against Redwinged Blackbirds in corn fields when placed at 16 m intervals (Concover and Dolbeer, 1989). They suggested that the tapes can be effective only for high value crops that grow low to the ground and damaged heavily by the birds. Fazlul Haque and Brown (1985) found temporary protection to cabbage by using reflector ribbons. Similarly balloons and kites have limited success in deterring birds. Although woodpigeons have been successfully repulsed by kites the labour required to keep them aloft is a disadvantageous factor (Fazlul Haque and Brown, 1985). Ballons were effective in protecting early sown barley from Rooks upto 13 days but not later sown oats (Feare, 1974).

Although initial response to scarers is withdrawal, repeated encounters lead to more information being gathered about the scarer leading to modification of cognitive map which approximates with the actual sensory input from the scarer. This in turn leads to diminished rates or withdrawal, gradually approach and finally all response to the scarer ceases with the object becoming familiar component of the environment. In otherwords habituation occurs. Habituation can be retarded by employing scarers which are uncommon and by using a range of devices both of which slow down the rate of acquisition of information about the scarer. Other measures which decrease habituation are: exposing the device for short periods, by randomly shifting its position, changing the timing of exposure and removing the ineffective scarers immediately (Ingles, 1980).

A second approach to diminish habituation to visual scarers is based on avoidance conditioning. This involves associating the stimuli responsible for avoidance with a subsequent aversive stimulation i.e., exposure to stress. Here the first stimulus namely visual scarer becomes a warning signal to the subsequent aversive stimulus. In an agricultural field the most effective aversive stimulus is shooting, as the sight of wounded, dead or dying conspecifies is highly aversive to birds. However, the approach can be successful only if the two stimuli are spatially and temporarily synchronized. In other words the scarer should be exposed just before shooting and should disappear immediately (Ingles, 1980). Propane gun or exploders or banging metal tins can substitute shooting in India.

Scarers based on Natural Alarm Stimuli

These are called *Biovisual scarers*. Many species of birds have genetically built in escape response to cues associated with the presence of predators which is subsequently modified by experience and learning. Based on predator-prey relationship and intraspecific signals two types of scarers have been developed namely *Interspecific scarers* delivering stimuli from species other than pest which is usually some son of a model of predator-raptor or human. The *intraspecific devices* incorporates either the

warning signal emitted by pest species on sighting a predator or the postures of feeding birds denoting lack of attractive food supply in the field. The biovisual scarers have two advantages over the novelty based ones in that habituation to these are slower and secondly the intensity of response produced by the pest bird is greater.

Interspecific scarers include : a) Models of raptors, b) Scare crows (Human effigies), c) Stimulli evoking fleeing/flight and d) Raptor Models.

a) *Models of raptors* —Two factors determine the efficacy of raptor mode is viz., the process of predator recognition and the type of strength of anti predator behaviour displayed once the predator is recognized. Earlier it was thought that few simple and general visual cues are adequate for predator recognition (Tinbergen, 1951; Melzack, 1961) implying that crude cut outs of generalized raptors can be effective as scarers. Later workers (Curio, 1975) argued that species specific detailed and complex visual cues such as plumage characteristics are involved in predator recognition. However, these seem to represent two extreme views. Thus it becomes advisable that cues involved in predator recognition can be studied for each species as a prerequisites for models.

Inglies (1980) feels that some cues like the body outline and mode of flight of predator while hunting are reliable cues for designing a raptor model. Sensitive experiments of Hamerstorm (1957) showed that prey birds are capable of recognising whether a predator is hungry or well fed by postures displayed by the latter. It is also postulated that a scarer incorporated with a super normal stimulus by exaggerating the sign stimuli or by combining several relevant sign stimuli from several predators can elicit above normal aversive effects (Inglis, 1980). The lone experiment conducted in this direction by incorporating a shrike model with an owl's eyes and an owl model with shrike's eye spots failed to scare the prey, the Pied flycatcher (Curio, 1978). The failure was attributed to perception of this mixed model as 'novel' birds. But still with a single failure the possibility of a super stimulus eliciting super normal responses cannot be ruled out. Atleast it is worthwhile to find out if supernormal stimulii are associated with a predator.

Once appropriate cues are recognised, the designing of a raptor model should take into consideration factors which retard habituation. Stimulii eliciting mobbing are known to enhance fear of scarer and slow down habituation. Curio (1978) explains this by *cultural transmission theory* according to which birds learn to fear an object once they see it being mobbed. Atleast six bird species have been recorded to exhibit this behaviour. Mobbing was shown to be enhanced by displaying the predator holding a dead model of the mobbing species (Barsh, 1976; Kruuk, 1976). Further periodic playback of the mobbing call may retard habituation (Inglis, 1980). Other factors which increase the effectiveness of a scarer are making the support for scarer as inconspicuous as possible and frequent moving of predator models. Successful scarers include falcons mounted on flats to deter waterfowl from small ponds (Howard *et al.*, 1985) and owl models holding live feathered starling (Conover and Pserito, 1981). Museum mounts of two specimens of hawks were ineffective in reducing damage by blue jays, starlings, mocking birds, mourning doves and houses finches with habituation occurring within 5–8 hours (Conover, 1979). However, the author found moving models or models with moving 'captured' prey were more successful. A later study by him (Conover, 1985) revealed that scarers in a vegetable field were successfully repulsed by a scarer holding a crow model whose wings moved in the wind and by another scarrer holding crow models whose wings were battery operated. These devices reduced bird damage by 81% compared to a still plastic mode.

A survey of use of visual scarers to protect crops in India reveal a study each on reflector ribbons and models of dead conspecifics. The former was shown to deter parakeets, mynas, crows, rosy pastor and bayas in the crop fields of Gujarat while stuffed models of crows were effective against crows in Hyderabad (Anon, 1982–87).

b) *Scare crows (Human effigies)* are the most ancient bird scarers. Though theoretically sound, the models fail because they do not accurately present the alarm stimulus. Examples of effective scare crows include a 3-dimensional human effigy whose head and outstretched arms move periodically (Inglis, 1980) and an inflated human effigy placed on cable and moved in fields and orchards in Britain (Achiron, 1968). A carbon dioxide pop-up scare crow acting in synchrony with a propane exploder has been shown to be effective albeit costly in America (Cummings *et al.*, 1986). Flemming (1990) refers to use of human beings as scare crows in Africa who stand on raised platforms throughout the crop period and throw stones at birds which land on the crop.

c) *Stimulii evoking fleeing* — are known to be of two types. The first is eye spot. An eye spot is a circular pattern which resembles a vertebrate eye which upon sudden exposure elicits escape reactions in several species of Passerines. The fright is attributed to resemblance of eye spots to the eyes of large raptors and those of conspecifics during threat displays, both being alarming to pest birds (Blest, 1957; Scaiffe, 1976b). The most frightening configuration of an eye spot contains two circular eye spots arranged horizontally each with concentric rings of bright colours. (Blest, 1957; Goss, 1972; Scaiffe, 1976a, 1976b). Inglish *et al.*, (1963) after studying responses of captive starling to different eye pattern concluded that a pair of 3-dimensional glossy eyes are highly aversive while Shirota *et al.*, (1983) found large balloons painted with eye spots deterring starlings from cherry orchards. The second stimulii that effectively induces flight is the sight of a man walking leisurely with outstretched arms, moving them slowly towards a flock of feeding birds (Markgren, 1960). The alarm elicited was attributed to resemblance of man's posture and movement to the approach of an eagle flapping its wings slowly. From time immemorial labourers are hired during growing stages of crop in India to scare the birds by walking leisurely in the fields, shouting and pelting stones on sighting flocks of feeding birds (Sridhara *et al.*, 1984). Recently Brent Geese damage to winter crops was alleviated in Britain in a cost effective manner by

employing a man, full time with a motorcycle to scare the birds in conjunction with alternate food crops adjacent to maincrop (Vickey and Summers, 1992).

Intraspecific devices are of two types : (i) those based on using corpse or models of corpse of pest birds and displaying them in unnatural and unhealthy postures (ii) Secondly employing models that mimic prefight, alarm postures of pest species.

i) Using unnatural body postures : A series of experiments demonstrated that decoys with open wings and models of birds with open wing posture deferred woodpigeons from landing on agricultural fields in Britain (Murton, 1970; Murton *et al.*, 1974). Wings placed in a clover field and models of woodpigeon in open wing posture reduced damage to clover and cabbage fields, respectively (Issacson, 1980; Hunter, 1974). As to the exact course of alarm elicited, Inglis (1980) rules out the possibility of unnatural body postures being perceived as 'novel' because of the capacity of woodpigeons to form complex visual concepts. It is likely that decoys are recognised as corpse of conspecifies which in signal the presence of predators and surplus killing by them. This perception is enough to elicit alarm flight. Further conclusions were drawn that only openwinged decoy elicit flight and not closed-winged ones suggesting the presence of an intraspecific sign stimulus in open winged devices which creates alarms. The author postulated that this could be the wing marks visible only during open winged posture. If this was so, it prompted Murton (1974) to further suggest that white mark if really is the sign stimulus evoking flight, then it can be exploited as a super stimulus. This indeed was the case as demonstrated later by Inglis and Issacson (1987) when simply a pair by woodpigeon wings, with enhanced wing marks using white paint and placing them slightly at a higher level protected crops from wood pigeon damage establishing that it is not necessary to use the whole body or life like models.

(ii) *Normal intraspecific signals* act either by denoting absence of attractive food or by alarm as in preflight postures. The hunched roosting models of great blue herons (Kraba, 1974) and head up posture of brachial geese (Dent and Swierstra, 1977) convey absence of high density food and thus discourage conspecific flying overhead from landing on crop fields.

After evaluating various postures of Brent Geese, Inglis, and Issacson (1978) found that the posture exhibited by he bird when alarmed was most effective in deterring birds from landing on crop fields. In this posture the body was angled upboard, neck was extended vertically and was pointed slightly upwards. In another study Raveling (1969) found preflight/alarm posture with heads shaking slightly when wind blow to be effective to deter Canadian Geese from trying on crops. These studies again emphasize the recognition of sign stimulus to incorporate into even intraspecific models.

To sumup, bird pest management may be rendered effective in India by using fertility control of commensal birds, changes in cultural practices and using, plant derived chemicals. Human scarers, predator models with wind blown movement coupled with sudden sounds, use of a variety of sacrers, changing the position of scarers, etc. seem to offer satisfactory non-lethal approach to prevent bird damage to crops. However, final recommendations can be made only after considerable research is carried out on these aspects.References

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Effect of Insecticides on Birds

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After the banning of chlorinated hydrocarbon insecticides like DDT, Aldrin, Dieldrin Chlordane, etc., the problem of bioconcentration and biomagnification have considerably ceased. This has reduced chronic toxic hazards among birds. However, the later generation insecticides particularly organophosphates and carbamates prove to be hazardous by their acute toxicity to birds inhabiting agro as well as forest ecosystem. Most of these insecticides are non persistent or less persistant. However due to their extreme acute toxicity, they kill birds instantly even in small doses. The problem become more acute by careless handling without any ecological consideration.

Among organophosphorus insecticides, Fenthion Methyl Parathion, Monocrotophos, Phorate and Phosphamidon are extremely toxic and should be discouraged from being applied to bird associated cropping systems. Malathion, Fenitrothion, Chlorpyriphos, Phosalone and Dimethoate are relatively less hazardous to birds. This has bee proved by field population studies and laboratory feeding experiments.

Among Carbamates, Carbaryl is less toxic than organophosphorus insecticides. Eventhough Carbofuran and Aldicarb are very highly toxic to birds, these insecticides are applied only into soil and covered *in situ*. This method of application safeguards birds from toxic effects.

Detailed studies on the effect of insecticides on insectivorous and graminivorus birds are wanting in our country. With references to increased farming activity and pest control operations with highly toxic insecticides, such studies become highly imperative and needs special focus from ornithologists and environmental toxicologist. .PA

Population Trends of Columbids in The Punjab Agroecosystem

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Of the seven species of columbids found in Punjab, six were recorded from the study area located in central Punjab. We studied their population trends from October 1988 to July 1993 through transect surveys covering an area of 7.3 x 0.1 km^2. The transects were situated in cultivated area (having fodder, horticultural, cotton, vegetable, pulse crops, etc.) and uncultivated area (dairy farm, lawns, bee-farm, buildings, forest block, tree rows, etc.). The population density of the columbids differed significantly ($F = 136.7$, $P < 0.00001$). Ring dove was the most abundant (183.9 /km ^{2}) followed by Blue Rock Pigeon (61.4/km^2), Green Pigeon (20.4/km^2), Spotted Dove (12.3/km^2), Little Brown Dove (8.5/km^2) and Red Turtle Dove (4.0/km^2). Rufous Turtle Dove was not encountered in the study area. The total columbid density (annual average) was found to be 290.4/km^2. Less traversed, unsprayed, uncultivated and fodder areas were preferred by Ring Dove ($F = 12.57$, $P< 0.001$), Red Turtle Dove ($F = 6.00$, $P < 0.001$) and Little Brown Dove ($F = 10.28$, $P < 0.0001$) to other areas. Green Pigeon was more common in transects having indigenous trees ($F = 3.88$, $P< 0.002$), whereas, Blue Rock Pigeon preferred transects having vegetables, pulses, maize, wheat etc. ($F = 9.71$, $P 0.001$). Spotted Dove preferred less traversed fodder and dairy farm area ($F = 6.07$, $P < 0.0001$). For all columbids undisturbed and unsprayed fodder area and dairy farm areas were equally preferred.

The total columbid population varied significantly among months ($F = 2.37$, $P< 0.01$). High Population density was found in February (498/km^2) followed by march (382.2/km^2), January (373.2/km^2) and December (337/km^2). A minor peak in population was observed in July (327/km^2) with minima in April-May (185.4, 186.6/km^2, respectively) and September (204.6/km^2). These differences were due to the differences in the population of Ring Dove, Red Turtle Dove and Spotted Dove. Both the pigeons and Little Brown Dove did not show significant differences in populations in different months. Ring Dove and Spotted Dove showed coinciding peaks in February, while Red Turtle Dove peaked in July.

Survey of Insectivorous Birds of Thalaimalai Forests

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Introduction

The avifauna in India is rich and diversified with 2,060 species and subspecies (Ripley, 1982) of which nearly 85% are insectivorous. As voiced by the eminent ornithologist Salim Ali (1977), a detailed ecological study of these insectivorous birds with reference to agricultural and forest ecosystems is a longfelt need of Indian Ornithology. In Tamilnadu studies were made on the identification of birds associated with agro-ecosystems (Thirumurthi and Abraham, 1975; Thirumurthi and Krishnadoss, 1981; Thirumurthi *et al.*, 1981; Francisnathan and Rajendran, 1982; Thirumurthi and Balashanmugam, 1987 and Thirumurthi and Balagurnathan, 1972). The insectivorous birds associated with forest ecosystems however, remained unstudied. A comprehensive survey has therefore been made on the insectivorous birds inhabiting the Thalaimalai forests situated in Periyar district of Tamilnadu between 1990 and 1992.

Material and Methods

The Thalaimalai forests, located in Sathyamangalam taluk of Periyar district covers about 1,50,000 ha with the rivers Mayar and Bhavani confluencing at the south western end forming the water body Bhavanisagar reservoir. The annual rainfall in the forest area is around 650 mm with 60% precipitation received between mid-September and mid-November. Large areas of ricefields and gardenlands are available on the southern and eastern side of the area with hill ranges of Niligiris, Bargur, Thalavadi and Biligirirangan situated on the north western and northern side.

The Thalaimalai forests are predominantly thorny jungle type with intermittent populations of larger trees. The vegetation mainly includes species of *Acacia, Albizia, Azadirachta indica, Terminalia, Delonix regia, Ficus, Dalbergia sissoo, Peltaphorum* sp., *Moringa* sp., and *Bamboosa* spp.

A total of 12 visits were made per year. The observation period lasted between 0700 to 1000 hrs in the morning and 1530 to 1830 hrs in the evening. There were six locations each spreading to about 200 ha and each of these locations were visited twice a year. The birds were spotted with a pair of 7 x 50 binoculars. Birds were identified using Ali and Ripley (1987).

Results and Discussion

A total of 112 species of insectivorous birds were identified during the survey. These belonged to 12 orders and 27 families. The order Passeriformes remained the largest, accounting for 64 species accommodated in 14 families (Table 1). Calliformes and Coraciformes ranked next with 8 species each, followed by Ciconiformes, Falconiformes, Cuculiformes and Piciformes each accounting for 5 species. The Passeriformes family Muscicapidae was the single largest family with 24 species. Eleven species were visitors active here from October to March.

Of the insectivorous birds, 34 species fed exclusively on insects while 8 also fed on rodents. These include Drongos, Babblers, Warblers, Swallows, Swifts, Wagtails, Hoopoe, Nightjars, Flycatchers and Bee eaters. The Owls and raptors feed on rodents also along with insects. Thirtyfive species feed on nectar and play a vital role in ornithophily of forest trees besides their pest management role. Some of the insectivorous birds were also found to feed on berries, shoots or grains.

In Thalaimalai forests, Woodpeckers were observed to destroy larvae of *Indarbela tetraonis*, a bark boring caterpillar affecting teak, Ailanthus, Acacias, Cassias, Jack, Moringa, etc. These birds also feed on cerambycid and buprestid borers infesting Mango, Moringa, Kapok, Teak, Eucalyptus, Cashew and Ficus. The grubs of *Batocera rufomaculata, Acanthophorus serraticornis, Placoederus ferrugineus, Olenocamptus bilobus*, and flatheaded borer grubs affecting several trees are eaten by woodpeckers in Thalaimalai forests. These birds were also found to feed on cicadas and termites.

Swifts and Swallows are typical of devouring insects in flight itself. Aphids, plant bugs and moths form the major components of their food (Fletcher and Inglis, 1926; Ali, 1940; Thirumurthi and Abraham, 1975; Mathew *et al.*, 1978; Thirumurthi and Krishnadoss, 1982). During the present survey the birds were found to be associated with the emergence of winged termites just after rains.

Orioles were reported to be effective predators of Ailanthus defoliator, *Eligma narcissus* (Chatterjee *et al.*, 1969). During the present survey all the three species of Orioles and four species of Drongo were found to feed on *E.narcissus* on Nilanthus. They were also observed devouring the larvae of teak defoliator (*Hyblaea Peura*), Pongam pentatomid (*Cyclopelta dissifolis*), Cicadas on Acacia trees and green weevils. The koel (*Eudynamys scolopacea*) was found to feed on hairy caterpillars such as *Euproctis* spp., *Taragama siva, Euptrote* sp., *Metanestra hyrtaca* and *Pericallia ricini*. Sunbirds besides feeding on flower nectar were found to consume soft bodied insects such as mealybugs and soft scales. The cushiony scale, *Iceryia aegyptica* infesting many forest trees was found at Thalaimalai preyed upon by *Nectarinia zeylonica* and *N.asiatica*.

Pollution of any kind has not so far been confronted as a problem of birdlife in Thalaimalai reserve forests. However, the increased use of pesticides in Thengumarchada agricultural settlement and industrial affluents let into the river Bhavani could be detrimental to aquatic birds. The

stone crushing units emitting fine dusts of granite on the southern tip of the forest could be hazardous to local bird populations of inhabiting the thorny jungles.

The insectivorous birds inhabiting the Thalaimalai forests are highly beneficial devouring forest pests and agricultural pests.

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Table 4 : Number of families and species in different orders observed in Thalaimlai forests

Order	No. of families	No. of species
Passeriformes	14	64
Galliformes	1	8
Goraciformes	4	8
Cuculiformes	1	5
Falconiformes	1	5
Ciconiformes	1	5
Gruiformes	2	3
Strigiformes	1	3
Piciformes	1	5
Apodiformes	1	2
Caprimulgiformes	1	2
Chardriformes	1	2
Total	29	112

Table 2 : Major trophic classification of Insectivorous birds of Thalaimalai Forests

Feeding habits	No. of species
Insects alone	33
Insects and plant parts	45
Insects and flower nectar	35
Insects and rodents	8
Insects and fish	18
Insects and grains/seeds	28

Crop Loss Assessment Due to Birds

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Introduction

Birds cause severe economic losses to agriculture. Studies in India have revealed that Roseringed Parakeet (*Psittacula krameri* Scopoli), House Crow (*Corvus splendens* Vielliot), House Sparrow (*Passer domesticus* Linn.), Indian Myna (*Acridotheres tristis*), Weaver birds (*Ploceus philippinus*), Munias (*Lonchura* spp.) are the common depredators of crops (Anonymous, 1992). However, no clear assessment of the economic loss to crops by birds have been made. This paper suggests the crop loss assessment methods due to birds damage under Indian conditions.

Material and Methods

To explore the applicability of crop-loss assessment methods the following crops were selected: Rice (*Oryza sativa*), Pigeon Pea (*Cajanus cajan*), Soybean (*Glycine max*), Chickpea (*Cicer arietinum*), Finger millet (*Eleusine coracana*), Sorghum (*Sorghum* vulgare), Sunflower (*Helianthus annuus* Linn.), Maize (*Zea mays*), Coffee (*Coffea arabica*) and Cardamom (*Elettaria cardamomum* Maton).

Results and Discussion

Data collection

Crop loss assessment requires collection of a large amount of data. The first step involves the definition of the format under which data should be collected. In field, this involves the sampling procedure, stage of crop, bird-pest numbers and extent of damage. The "field book" or "paper and pencil" method of data recording is the traditional method (Teng, 1984). The data can be keyed into a computer file. Assessments and field notes can be recorded on a small portable recorder such as a dictaphone or small cassette recorder. This method appears to be suitable for 'closed' habitats like cardamom, coffee estates and forests. This usually involves playback of the tape and transcription of information to written or printed records before computer entry and analysis and for record-keeping (Bowen and Teng, 1992). However, the high cost of the equipment is a limitation.

Electronic notebooks, portable computer, remote sensing, video image analysis and radiometer measures of sunlight reflected off-plant surfaces are forms of data recording without human estimation of damage (Ellington *et al.*, 1985; Gerten and Wiese, 1984; Lindow and Webb, 1983; Pederson, 1984; and Pedersen and Fiechtner, 1980).

Crop-loss Assessment Methods

Bird-pests can be counted directly or their numbers estimated or their effects on crops assessed indirectly as injury or damage. Number of birds can be expressed based on the crop area. In practice, the method must give as true an estimate of the actual numbers of birds as possible as has been done with regard to certain insect pests (Walker, 1980; 1992). Walker (1992) also outlined a pest management system based on pest assessment and crop-loss assessment, that is applicable to bird situations too (Fig.1).

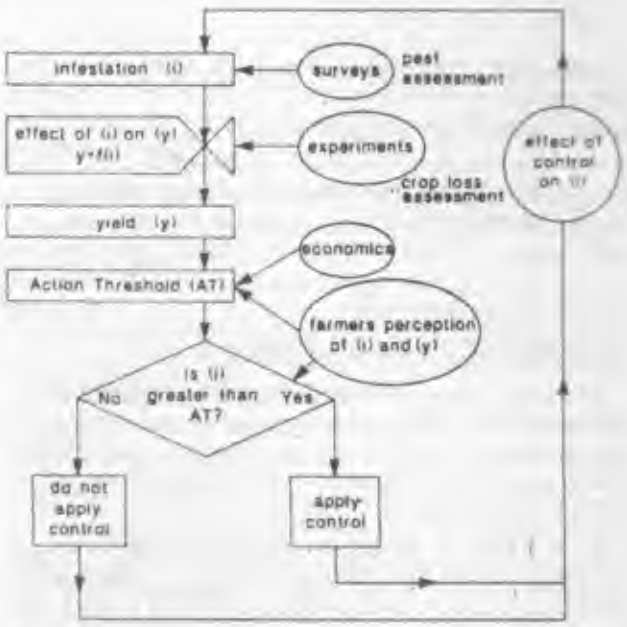

Fig.1. A pest management decision system, showing the place of pest assessment and crop loss assessment.

For each crop indicated above, crop-loss assessment methods are described below.

Both direct (where bird numbers are considered) and indirect (where extent of damage/loss is involved) methods are described. While doing so, the bird-pests, crop-stage involved, nature of damage and important ecological considerations are also briefly mentioned.

Rice

In South India, rice grains are mainly fed upon by Sparrow-sized finch birds like munias (5 species of *Lonchura*), Weavers (2 species of *Ploceus*), House sparrow (*Passer domesticus*) and Parakeets (4 species of *Psittacula*).

It was observed that within a patch of feeding period the flock size of birds remains almost a constant. The numbers of granivorous birds as mentioned above may vary over the

entire Rice growing season. But birds incur losses only during grain formation and grain filling stages lasting for about 30 days. In this period, numbers of birds may not vary much. Therefore, for an open habitat like rice fields, it is rational to assume homogeneity in detectability (d) and negligible or no within- season variation in numbers.

Validity of the count (by binoculars) can be increased if the same observer in the same patch during grain formation and grain filling stages, records bird density at fixed time (particularly when birds are perched). Counts of individuals in a large feeding flock is difficult as birds go on shifting. Counts can be taken on clear days avoiding rainy/cloudy days. Numbers of birds during a sample count is given by

$$\sum_{i=1}^{K} X_i$$

X_{ij} where X_{ij} is the bird count at j th time instant in the i th field

where $j = 1, 2, 3, 4 \ldots t$ time interval
$i = 1, 2, 3, \ldots n$ fields. This is based on the assumption that detectability of all species is almost equal to 1.

Density of birds is given by

X_i where X_i is the number of birds in ith flock

There are many potential sources of variation of avian counts. Variation due to sampling procedures, changes in bird behaviour with time of day, weather, detectability among species, etc. (Shields, 1979) which are minimized by this method of count.

In Mandya, a district in South Karnataka rice is cultivated in patches amidst sugarcane (*Saccharum officinarum*) fields. In this situation it is difficult to count the birds. The granivorous birds take refuge in sugarcane fields to feed on rice grains, incurring usually more losses than in monoculture patches of rice.

In such situations, clumps or panicles can be conveniently taken as the units to measure the amount of yield-loss. Since it is cumbersome to count the grains lost through bird depredation, panicles damage to varying extent can be summed-up and expressed as number of panicles or clumps lost/unit area. The average amount of grains yield/panicle or clump should be known to estimate the yield-loss.

The yield-loss by birds in rice can also be expressed on area basis, which in turn can be converted to number of plants/clumps or earheads. For instance, the White-beasted waterhen (*Amaurornis phoenicurus*) during nesting,cuts the culms of all tillers in a clump.

The weavers and other passerines were observed feeding their chicks with insects injurious to rice grains. So, while considering the losses due to these birds, the loss prevented via insect-pest predation need to be considered. This is essential for the overall management of problematic birds, insect and other vertebrate pests in the rice agro ecosystem.

Pigeon-pea, Soybeans and Chickpea

Pulses like Pigeon-pea, Soybeans and Chickpea are frequented by Pigeons to feed on seeds. The Roseringed Parakeet, *P. krameri* has been observed feeding on soybean pods. However, the seed damage to pulse crops is more widespread and so the discussion will be confined to only the Pigeon problem. The distribution of Pigeons and hence the seed damage is highly clumped. Pigeons do not feed on seeds throughout the day but at specific times feed on seeds. So a large area need to be surveyed at feeding time to get a reliable estimate of numbers of birds. Pigeons scoop out mud to feed on fresh sown seeds. The birds are also in the habit of storing seeds in their 'pouch' to feed at rest later. Counting birds at specific time over a large area is difficult, tedious and not practicable. In such a situation, estimate of numbers based on number of counts per say 0.5 km would be reliable. If observer speed is held constant, then the effort indicator (individuals/unit effort) will determine the spatial scheme or the transect pattern appropriate for sampling. It would be a scheduled or random route (on a vehicle preferably) through a plot without regard to repeat samples. Here the aim is to sight maximum number of flocks feeding in the area surveyed. Maximum number of individuals counted on a day can be used as an estimate of numbers for that day. A temporal variations are minimized in this case as the feeding on seeds by Pigeons do not extend beyond a week. The estimated numbers is given by

$$\sum_{i=1}^{K} X_i$$

X_i where X_i is the bird count at the ith count station and k is the number of such stations.

A number of insectivorous birds frequent fields of these crops and this consideration is important in the yield-loss assessment. When the sampling area is large and damage is extensive the seed-loss can be expressed on area basis. Number of seeds/unit area should be known.

Fingermillet, Sorghum and Maize

The technique of counting birds by binoculars in rice agroecosystem can with modifications be followed in agroecosystems of Finger millet (*Eleusine coracana*), Sorghum (*S.vulgare*) and Maize (*Zea mays*).

In addition to the species that feed on rice, Crows (*Corvus splendens* and *C.macrorhynchas*) also feed on these grains of these crops. Because of the plant architecture and partially 'closed' crop canopy the detectability (d) of each species would vary. The detectability of birds like Parakeets and Crows (large sized birds) would approach 1 (Perfect detectability) on fingermillet and sorghum. While that of munias and weavers (small sized) could be less.

On above three crops, it is suggested to count birds species-wise and the detectability of each species at a given patch be established prior to count. If it is not practicable to count each species, birds based on the size

be classified as small-sized, medium-sized and large-sized birds.

The number of birds at a patch is given by

For small-sized birds

$$\sum_{i=1}^{s} \frac{N_i}{d_s}$$

N_i is the number of small sized birds in ith field
i = 1, 2, 3, 4 ... s
d_s is the detectability of small sized birds

For medium-sized birds

$$N_j/d_m \sum_{j=1}^{m} \frac{Ni}{dm}$$

where N_j is the bird count of medium sized birds in jth field. There are 'm' such fields,
d_m detectability of medium-sized birds.

For large-sized birds

$$\sum_{j}^{i} \frac{N_k}{d_j}$$

where N_k is the number of large sized birds in the kth field. There are I such fields
d_j = detectability of large-sized birds.

If it is difficult to assure homogeneity in detectability during a count, then consecutive counts during the same crop stage can be compared. Alternatively, validity can be increased by adding a separate control area, i.e. a patch not included in the study area. Bird damage can be expressed in terms of number and length of cobs and number of ears in a homogeneous patch. In which case, grain weight/unit plant-part should be determined.

Sunflower

Sunflower is an important oilseed crop and in India Parakeets (*P.krameri*) are the principal species feeding on seeds. Some of the other species of birds causing damage to sunflower in India are House Sparrow (*Passer domesticus*), Redheaded Bunting (*Emberiza bruniceps*), Yellow throated Sparrow (*Petronia xanthocollis*), Spotted Dove (*Streptopelia chinensis*) and Western Turtle Dove (*Streptopelia orientalis*). These species alight on sunflower from different perches and feed at different spots in the same patch at the same time. Each group of bird followed a clump distribution pattern. Parakeets, Doves and Finches have different modes of feeding and incur losses to varying extent in seed yields. An account of the interaction of birds in Sunflower agro-ecosystem is dealt with in this volume. Birds prefer feeding on Sunflower for not more than 30 days. If a transect at fringe areas of the field would permit a clear view (through binoculars) of birds feeding on seeds, then a valid estimate of numbers could be obtained. Else, valid estimates of numbers can only be made of the relation between detectability (d) and density (n) is known or controlled.

This can be accomplished by using counts unaffected by (d) or relationship between contact (c) and (d) is measured or a factor established.

Under Indian conditions the (d) values for each species in each patch would vary, i.e. estimates for small areas can only be measured. Transect counts, being suitble for any small homogeneous habitats such as Sunflower agroecosystems during any season can be adopted. Before fixing the area and position of the transect, the contact distribution with the bird flocks need to be ascertained. As the flocking, feeding and foraging behaviour and detectability of each group varies, a variable belt may be chosen. The transect is decided based on preliminary findings of earlier grounds of survey. The count can be taken 3 to 4 times in a season. The number of each species of bird can be estimated by

$$C_i = \frac{N_i}{d_i}$$

where N_i is the number of contacts of ith species with detectability d_i (N_i is the average of counts taken on time or at different times).

Multiple counts at different feeding times of the day can be performed and then averaged. This will tend to balance the effects of localised movements around the transect and also the increase or decrease in numbers.

The bird damage can be expressed as percent head damage (for details see this volume). Number of seeds/unit head-area should be established.

Coffee

Coffee (*Coffea arabica*) berries in South India is grown under the shade of forest trees with overhead multiple layers of vegetation. Coffee barriers are depredated mainly by bulbuls/species of *Pycnonotus* and *Hypsipetes*. Methods for bird counts in forest-like habitats has been developed by Emlen (1971; 1977).

Among birds, Jungle Crows, Coucal, Parakeets, Munias, Sparrows, Bulbuls and Barbets are the important species that supplement their diet with coffee berries.

A preliminary survey of the plantation can be made to fix the transect path. Depending on the topography, plantation can be divided into sectors or blocks. After deciding the size (width X length) of the belt in each sector, birds are counted either on sighting or on cue emission. The number of birds for the entire plantation is given by

$$C = \sum_{i=1}^{k} \frac{N}{2TW}$$

where T is the length of the transect, w = width of the belt.

Cardamom

Cardamom is grown in 'closed' habitat or valley regions in evergreen tropical forests with multiple layers of vegetation. Fruits (called as capsules) are borne on ground under cardamom canopy. Ground foraging birds like Red Spurfowl (species of *Gallus*), Ground Thrush (species of *Zoothera*), etc. depredate on capsules by splitting them.

sipping the mucilaginous and matter leaving the seeds on ground. The obstrusive coloration and concealing behaviour of birds make it difficult for the observer to register a contact with the bird, even if the bird is close. This is accentuated in cardamom agroecosystem. So the estimates of numbers depend on the emission frequency of detectable cues as well as on the cue attenuation function.

Cue production depends primarily on bird motion for visual cues and on vocal and mechanical sound production for auditory cues.

In Cardamom, detectability of birds is very less. The size of the main belt and pathway of transect can be decided by making preliminary surveys. When the crop is cultivated on large and uneven tracts, the entire area can be divided into a number of blocks/sectors. For each block, the main belt should be established and number of birds is recorded based on cue emission. The bird number is estimated as

$$Csibl = \frac{N_i}{2T_iW_i}$$

where T_i is the length of ith transect with half width of the belt (w_i).

Relation between bird numbers, damage and yield-loss

Crop yield is the amount of harvestable economic product such as grain, cob, fruit, berry or capsule. Yield can be expressed per unit of crop such as per plant, or kg/ha or tons/ac. Losses due to bird damage can be assessed by comparing the weight of attacked and unattacked plants/clumps/bush. Loss per attacked plant/clump/bush in terms per say 1000 grains/capsules/berries will give the total loss if multiplied-up by the percentage of grains/capsules/berries attacked. Data on bird numbers can be transformed to provide an estimation of yield losses by a product of number of birds/unit area x average number of feeding hours/day x average feeding rate/individual. Wherever feeding rates vary widely, specific feeding periods should be indicated. How crop is lost by bird attack is shown in Fig.2. Crop loss (w) in the presence of pests is expressed as the percentage reduction in the potential, maximum yield in the absence of pests (m). If the yield in the presence of pests is Y_1 :

$$W = \frac{(m - Y_1)}{m} \times 100 \quad \text{(after Walker, 1992).}$$

One measurement of bird damage and yield is of very limited value. But three or more levels of bird damage would give a useful indication of how yields relate to a range of damage. The relation between damage and yield (y) is commonly expressed as a regression function.

$$y = m - b(d)$$

where m is the maximum potential yield in the absence of bird pests or where d = 0 and (b) is the rate of loss of yield. The relation between bird damage and yield loss could be straight line or sigmoid. The relation between bird density (numbers) and yield may be related to the log or power of bird density. Transformation of data may be necessary before analysis.

This paper summarises a collection of crop loss assessment methods due to birds relevant to Indian situations. Birds can be counted directly or their effects on crops assessed indirectly as damage. The crop loss assessment methods should be standardized and this needs considerable experience and data. Indian conditions offer a multiple system of diverse agroecosystems and bird species to work with. Then the crop-loss assessment methods can be modified or developed suitably based on practical situations.

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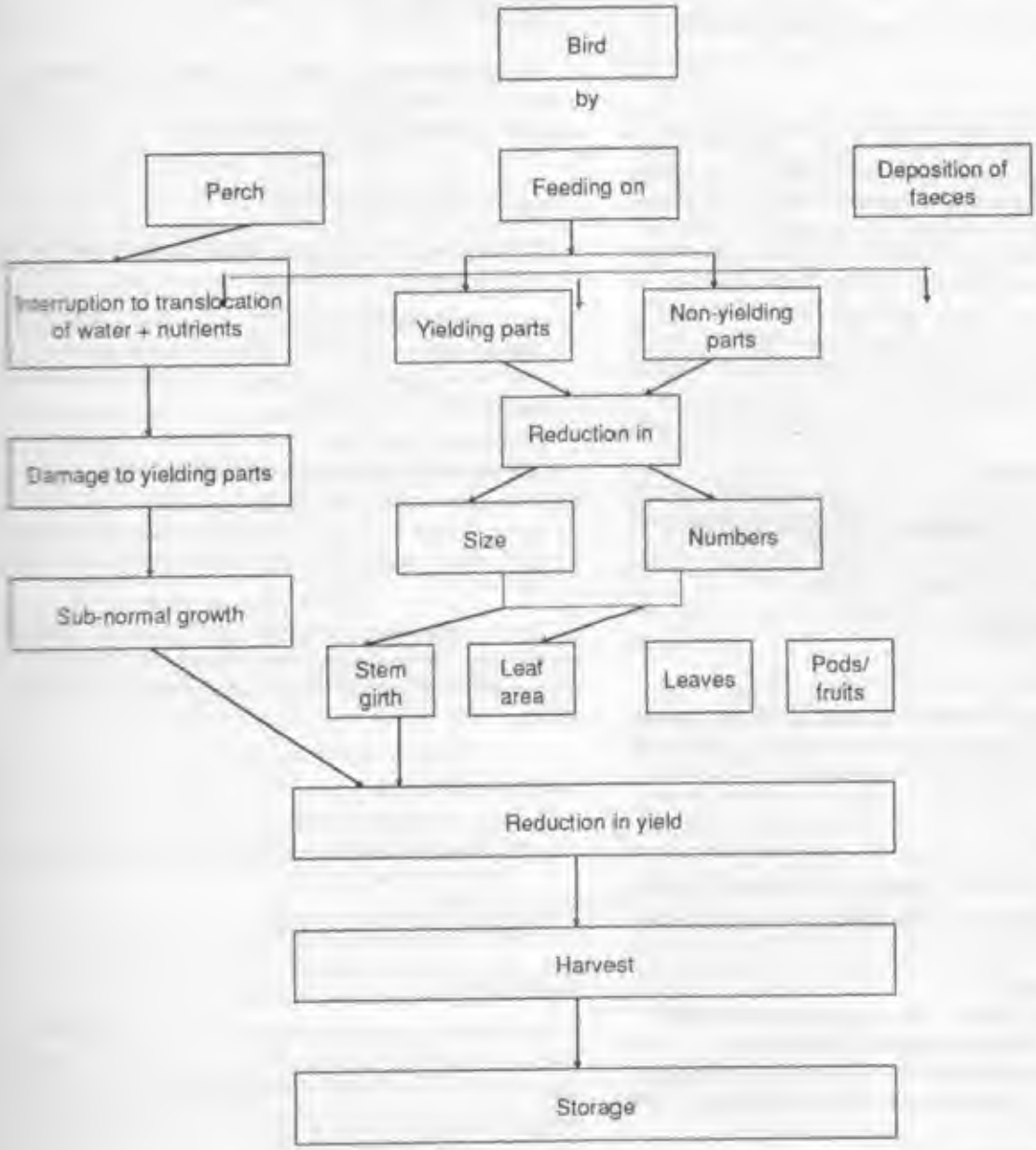
Fig.2. The way birds can cause crop loss



Foraging Ecology of Pestilent Parakeets

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Introduction

Parakeets (*Psittacula* spp.) are important vertebrate pests of agricultural crops. Their pestilence often assumes alarming proportions, especially in crops like sunflower, maize, wheat and safflower, depending on the geographical locality, vegetational diversity, roost-site, and so on. The management strategies for the parakeets are hardly known, as the foraging ecology is still not clear in most of the crops. The foraging ecology so far studied along with management principles is reviewed, so that a cohesive and feasible approach to management can be theorized for experimentation.

Material and Methods

Literature on the subject was collected, analysed and reviewed.

Result and Discussion

Taxonomic Position

Parakeets belong to the order Psittaciformes of class Aves, and is characterized by short, hooked bills. It is represented by the sole family Psittacidae.

Family Psittacidae

This family has six sub-families and about 60 genera with 330 species. The characteristic features are as follows :

1. Stout hooked bill
2. An enlarged fleshy cere covering upper mandible
3. Length of the birds vary from 8–102 cm
4. Upper mandible attached to the skull by a flexible joint that allows it to move up and down freely
5. Short neck
6. Plump body
7. Rounded wings
8. Legs short, covered with small granular scales
9. Feet zygodactyl
10. Color mainly grey, green or red (Ali and Ripley, 1983).

Distribution

This family is distributed mainly in the Tropics, but are also represented in the high latitudes of southern hemisphere. The chief areas, however, are Central and South America, West Indies, Africa, Australasia, Sub-Antartic Islands, New Zealand, Pacific Islands and Asia including India (Anon, 1979).

The genus *Psittacula* which represent the parakeets of India is found only in Asia. The genus has characteristic long tail extending beyond the wing tip.

Characteristic Behavioral Traits

The parakeets have four behavioral traits that influence its foraging and are as follows :

1. No defined foraging territory — as a result one can expect more number of birds per unit area. This can put more depredation pressure on crop plants being foraged by the parakeets.
2. Colonizers and flock formers — this contributes to group foraging; puts more pressure as a pest of crops.
3. Arboreal — essentially feeds on canopy, hence easily pests of tree and tall crops. But they also descend on low height crops like wheat, but never glean from ground.

These behaviour coupled with special feeding modification (given below) have helped in contributing to the pestilence of parakeets. (Ali and Ripley, 1983; Anon, 1979).

Feeding modifications

1. Short flat muscular tongue
2. Parakeet tongue has more taste buds per unit area than in other birds
3. Short bills
4. Powerful bills to crack nuts.

Food Range

The food is essentially vegetarian, hence important as agricultural pests. The exception is kea, (*Nector notabilis*) which is a carrion feeder. The following example would highlight the range of food which is from grains/seeds to nuts, leaves and flowers to fruits.

Bird	Food
Budgerigar (*Melopsittacus* sp.)	Seeds
Lorikeet (*Loriculus* sp.)	Nectar, Pollen
Pygmy parrot (*Micropsitta* sp.)	Slimy fungi, algae, seeds, (insects additionally)
Kakapo (*Stringops habroptilus*)	Leaves
Macaws (*Anodorhynchus*)	Nuts
Cockatoos (*Prtobesciger*)	Nuts
Corella (*Cacatus* sp.)	Insects (Additionally)
Indian Parakeets (*Psittacula* spp.)	Fruits, seeds, grains, flowers etc.

Parakeets of the Indian Subcontinent

There are atleast 13 species of parakeets recorded from the Indian Subcontinent, which also includes Burma, Bhutan, Nepal, Ceylon, Pakistan, Tibet, South China and Bangla Desh. These are as follows :

1. *Psittacula eupatria* — found throughout India and in Pakistan, Bangla Desh, Burma and Ceylon.
2. *P.krameri* — most common throughout India, and as a pest is economically most important. Also found in Pakistan, Nepal, Bangla Desh and Ceylon.
3. *P.alexandri* — restricted to the North and in Andamans in India. Elsewhere in Nepal, Bhutan, Bangladesh, Burma, Vietnam and China.
4. *P.caniceps* — found only in Nicobar Islands.
5. *P.derbyana* — found in Tibet and China. No record from India.
6. *P.longicauda* — found only in Andaman and Nicobar Islands.
7. *P.cyanocephala* — found in North upto between Gujarat and W.Bengal and down South. Also in Pakistan, Bhutan, Nepal and Ceylon.
8. *P.roseata* — found North and North-East in India. Also in Bhutan, Burma and Bangla Desh.
9. *P.intermedia* — distribution is not known. It was shipped in 1865 from Bombay as per records. A specimen is available at the Rothschild Collection of the American Museum of Natural History, New York.
10. *P.himalayana* — found in North and Pakistan.
11. *P.finschi* — restricted to North-East in India. Also in Bangla Desh, Thailand, Burma and Vietnam.
12. *P.columbodes* — restricted to Western Ghats in South.
13. *P.calthorpae* — restricted to Maldive Island (Mehrotra and Bhatnagar, 1979; Ali and Ripley, 1983) and wherever these species are found, they are potential pests on field or horticultural crops (Shivanarayan, 1982).

Foraging and related habits (Case study : P.krameri)

The general foraging habits of all the above parakeets is beyond the scope of this paper. Therefore, the most pestilent, *P.krameri* has been selected. This species, typical of parakeets, keeps in small parties, which often band to form large flocks and are seen descending on ripening crops such as sorghum, maize, sunflower, etc. They either bite into the ears or cut off a ear and fly to a perch, where it is raised upto the bill with one foot and discarded even before fully consumed. On trees they move in the canopy attacking semi-ripe to ripe fruits. The zygodactyl feet are well adopted for this movement within tree canopies (Ali and Ripley, 1983; Macdonald, 1960). In summer, they descend in large numbers on to flowers of trees like *Peltophorum* for nectar (Verghese and Chakravarty, 1977).

Foraging target species of P.krameri

The food range of the parakeet includes both cultivated and wild plants, and those specifically identified are as follows :

Fruits — Guava, grapes, mango, temperate fruits including plum and wild fruits of *Ficus, Zizyphus, Xanthium, Capparis*, etc.

Cereals — Maize, Sorthum, Bajra.

Seeds — Sunflower, Safflower, Groundnut, *Acacia arabica, Prosopis* sp. etc.

Pulses — Pods of all mature pulse in field including Dolichos, Horsegram, etc.

Nectar — of *Salmalia malabarica, Peltophorum feruginium, Erythrina indica, Butea monosperma, Bassia latifolia, Casuarina equisetifolia*, etc. (Ali and Ripley, 1983; Shivanarayan, 1982; Mehrotra and Bhatnagar, 1979; Verghese and Chakravarthy, 1977).

Foraging Pestilence

As mentioned earlier, *P.krameri* is the most important among parakeets as a pest in India since 1930's (Ali and Ali, 1938). However, in other countries where it is distributed, including Africa, it is not a serious pest (Banner Man, 1951).

From agriculture point of view, the parakeets mainly feed on cereals, oilseeds, pulses and fruits. In a study conducted in Andhra Pradesh, it was found that cereals comprised 57.83%, oil seeds 36.74% and pulses 30.72% in the diet of the parakeet (Shivanarayan, 1982). Further study from here showed that food (seed) consumption is less during summer (Shivanarayan, 1982) possibly on account of extra nectar intake to 'quench' thirst reflexes.

In a study on *P.eupatria* from Pakistan, Ali and Ripley (1983) reported the following diet distribution, based on stomach analyses:

Crop seeds	– 52%
Weed seeds	– 2.7%
Neutral seeds	– 11.4%
Vegetable	–4.8%
Cultivated Fruits	–19.0%
Wild Fruits	– 9.8%

The data clearly show that the parakeet is an estalished pest in agroecosystems.

Varietal preferences

As mentioned earlier, parakeets with a better sense of taste show discriminatory foraging among different varieties of a crop species. Bhatnagar *et al.*, 1982 screening bajra germplasm found that varieties with early maturity, more height, loose grain in ear head and loose stalk had higher infestation. Therefore, they concluded that varieties with late maturity, dwarfness, compact grains, and stiff stalk to be included in breeding.

In Safflower, Mahto and Bhatnagar (1982) found that spiny varieties JSP-1 and 116-4-5 had less boll damage (18.16% and 23–25%, respectively) as compared to nearly 60% damage in non-spiny varieties like NS-133 and 340092.

Reports in Anon, 1980, on maize gives interesting results. Parakeets avoided cobs at lower heights. With more of tightness in the outer spathe, infestation was less. In the varieties Pirals Piracicaba, Suwan, DMR Source 1, D Composite, Piranao, there was no bird damage, but were susceptible to *Chilo partellus*, Ganga 5 and Antigua Gri were resistant to *C.partellus*, but highly susceptible to bird damage. Suwan 1 and Thai Comp. were resistant to both. Bhatnagar *et al.*, (1982).

Control strategies

Scaring — Scaring using labour with rattling sounds, shot guns, sulphur crackers or stone slings seems to be theonly reasonable control device available in India. Using labour scaring, bird damage was reduced from 42–98.23% to 5.23–39.12% in sorghum (Santhaiah, 1982).

Acetylene gas exploder works for some time if location and frequency of sound are changed from time to time (Shivanarayan, 1982). According to him mounting the exploder on stand above the crop gives the best scaring effect. Further, this can be improvised by fixing a thin steel drum to amplify the sound for greater efficacy.

Use of 0.22 rifle or 12 bore shotgun is effective on short term basis, Anon (1983).

Acoustic repellents

Alarm calls of *P.krameri* have been recorded and played to dispel successfully the parakeet flocks. However, due to habituation and high cost of installation, it has not become popular (Anon, 1983).

Use of sticky substance

This is a common method elsewhere in developed countries. Non- drying and cheap adhesives are not easily available in India, hence, it is yet to be popular here. Stakes pasted with sticky substance like "Bird Tangle Foot" or "Stickem" trap birds, which can be caught and caged or destroyed. However, birds over a period learn to avoid such sticky stakes thus diminishing its utility (Anon, 1980, 1983).

Chemical Control

Repellents

Use of repellents have not found desired result in India. Experiments using methiocarb (3.5 — dimethyl-4-methyl-thio phenol methyl carbamate) 1% and 4 parts of sorghum as bait has not proved successful. Likewise repellent sprays of parathion and fenthion have not been effective (Anon, 1986).

Reflector ribbons

Reflector ribbons are coloured tapes with irridiscent colours of 0.5 cm width. As birds have high visual sense, these ribbons have high potential in disrupting the orientation of parakeets to crop ecosystems (Anon, 1986).

Foraging strategy

So far, no concerted efforts have been put to investigate into the foraging strategy of the parakeets, except for the study on guava. It was found that the birds descend on guava canopy and 'select' a mature fruit from the upper canopy. Bird damage with size and visibility showed poor correlation. Therefore, foraging optimization was more based on maturity than size. Search for desired fruits is evident from weak correlation of damage with visibility implying a non-random foraging strategy (Verghese and Prasad, 1985).

Future Suggestion

If a meaningful strategy has to be evolved to manage parakeets the following points have to be considered :-

1. The foraging strategies and ecological factors affecting the same need to be understood and modelled into prediction equations to enable forecasting in different agro-ecological zones with reference to crop seasonality.
2. It is widely believed that parakeets were originally birds of the wild and the depletion of natural food has gradually led to crop depredations, therefore, habitat manipulation in terms of planting wild trees bearing berries, flowers, fruits and seed will help decrease damage by parakeets.
3. Nest and roost destruction must be carried out in selected pestilent zones.
4. Use of resistant varieties seems very potential and should be fully exploited in breeding programmes.
5. Exploration of using buffer crops as diversion crops needs to be initiated.
6. Falconry can be attempted as a scaring technique.
7. Use of chemosterilants like Orintol and stupefying baits like Avitrol, Alphachloralone, can be attempted.

The foraging ecology of parakeets are poorly understood. The food range of parakeets and their general ecology with some control measures have only been studied. However, in the guava example, foraging ecology and strategy can vary with the (i) species of parakeet, (ii) the crop and (iii) the locality. So, the foraging ecology and strategy on a national grid basis has to be worked out and wherever it warrants, a combination of the above mentioned control measures need to be standardized. The comprehension of their foraging must be related to economics to manage the birds. Parakeets should not be

exterminated, as parakeets are lovable birds with aesthetic appeal.

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Foliage Damage to Areca, *Areca catechu* L. by Roosting of Rose Ringed Parakeet, *Psittacula krameri* (Scopoli)

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Areca *Areca catechu* is an important commercial crop being grown in 20,000 ha in Shimoga district. Currently farmers are earning profits to the tune of rupees one lakh per acre. Roosting of birds on trees is very common on the avenue and garden trees in Shimoga. But roosting of parakeets on areca was found alarming as it caused considerable foliage damage. Observations on this aspect is reported here.

Observations were recorded during 1992–93 on the impact of parakeets roosting on areca in a three-acre garden at Kagekodamaggi village, Bhadravathi taluk.

The areca palms were 15 years old and the parakeets roosts was limited to this garden. These birds did not directly cause yield loss in areca palms but were observed to roost in hundreds of individuals per palm. Their congregation started with characteristic noise at 6.30 p.m. and the commotion lasted for half an hour. Due to the congregation of birds, the fronds were subjected to heavy physical pressure. Hundred percent of the trees in three acres were subjected to foliage damage. The foliage damage ranged from 20 to 70 per cent with the average 38 per cent.

In addition to foliage damage, the guano of the birds spread all over the leaf surface resulting in reduced photo-synthetic activity. The injured fronds attained senescence early and fell prematurely. On an average, out of fourteen fronds/plant, eleven were affected. Average length of the frond in a healthy palm measured 170 cm, but that of affected palm measured 98 cm. Unopened leaves were not affected because of their erect nature. The production of nuts in the palm was also adversely affected by premature nut fall acrueing to yield loss. As per the farmer's statement, the loss was to an extent of 30%. Although rose-ringed parakeets are known to cause a loss of 16% in Maize cobs, 63% in Mustard pod yield and serious damage in grain and fruit crops (Simwat and Sidhu, 1973). No reports were encountered on foliage damage due to roosting. Dhileepan (1989) from Kerala reported the Lorikeet (*Loriculus* sp.) damage to oil palms feeding on fruits. Continuous use of crackers was helpful in warding off the parakeets from the areca garden.

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Table 1: Percent foliage damage and number of fronds affected due to parakeets roosting

Palm No.	Leaf area damage per palm (%)	Average No. of fronds/ palm	No. of affected fronds/palm
1	39	13	11
2	42	14	11
3	40	15	13
4	20	15	8
5	25	14	11
6	34	13	11
7	34	13	11
8	28	14	12
9	38	13	11
10	70	13	11
Mean	38.0	13.7	11.0

Status and Conservation of Avifauna of Aravalli Range and Mount Abu with Special Reference to Depletion of Avifauna in the Last Twenty Five Years

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Mid Aravalli range and Mount Abu have 1000 meter high deciduous forests with highest peak Gurusikhar at 1770 meter MSL, in the north west India. Avifauna of the region is of high ornithological interest. Ecological aspects of this range was observed for the last twenty five years from 1967 to 1993 and serious decline of avifauna of green mountain forests was noted. There has been clandestine illegal cutting of grass in the Aravalli range and Mount Abu for the last 25 years. Now the former forest thickets have been reduced to sparse forests. Grey Tit, Yellowcheeked Tit, Redwhiskered Bulbul, White-eye, Paradise Flycatcher, Green Munia, Scarlet Minivet, Golden Oriole, Blacknaped Oriole, Grey Hornbill, Chestnutbellied Nuthatch, Crested Bunting, Green Pigeon and the Crested Hawk-Eagle are the main avifauna of thick forests.

It was observed that thickets of *Mangifera indica, Ficus glomerula, Eugenia jambolana* and *Carissa carandus* and *Dendrocalamus Strictus* have been badly reduced by wrong forestry management and excessive and illicit tree cutting by the forest contractors. For the last 20 years planting of *Eucalyptus* spp. and *Grevillia robusta* have been emphasised in the region, which are unfavourable to avifauna of forest thickets.

Increase of forest reserves areas with rigid fencing and guarding against illicit and excessive cutting of trees and shrubs are needed.

Parakeet Damage to Marigold Crop

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Blossomheaded Parakeet, Psittacula cyanocephala and Roseringed Parakeet, P. krameri caused 64.7% damage to a seed crop of African Marigold, *Tagetes erecta* c.v. Cracker Jack. This is the first quantitative study on the parakeet damage to marigold. The blossomheaded Parakeet was the major depredator, whereas, the Roseringed Parakeet was an occasional visitor to the crop, probably due to difficulty in 'handling' the tiny seeds of marigold with its larger beak and availability of more profitable alternative food. The parakeets preferred the flowers nearer to their perching site and the damage caused at a particular point was negatively related to the distance from the perch ($r=-0.70$, P).

The side towards road suffered minimum damage (28.7%) which was significantly less than the damage inflicted on other sides (80.3%,84.8% and 69.9%, F-test, P), thus confirming their tendency to keep away from the human disturbance. The results of this study may be helpful in planning more effective and less expensive strategies for reducing bird damage to a crop in a particular situation.

Avian Predatory Habit on FCV Tobacco Aphid *Myzus nicotianae* Blackman and Its Influence on Yield

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Introduction

Wagtails are good predators of mustard aphid (Toor and Ramzan, 1975). Gupta and Yadava (1989) observed the predatory habit of *Acridotheres tristis* on cumin aphid *Myzus persicae*. Field bean aphid *Aphis craccivora* was efficiently predated by Yellow Wagtail, *Motacilla flava* and Grey Wagtail, *Motacilla caspica* (Chakravarthy and Lingappa, 1978). Tree Swallow, *Tridoprocne bicolor* and *Hirundo rustica* were observed predating on adults of larch sawfly, *Pristiphora erischsoni* (HTG)., (Buckner and Turnock, 1965). Guerrieri *et al.*, (1990) reported that, survival of *Hirundo rustica* colony depends on the dipteran insects availability in high numbers.

Flue cured virginia tobacco is an important commercial crop grown in an area of 30,000 ha. It is infested severely by aphid *Myzus nicotianae* affecting both yield and quality. Avian predators were observed to feed on the tobacco aphids. In the process of their feeding, birds caused loss by damaging the valuable leaf. This study was taken up to quantify the extent of damage to tobacco leaf.

Material and Methods

The observations were recorded on the predatory habit of the birds, *Acridotheres tristis*, *Acridotheres fuscus*, *Sturnus pagodarum* and *Hirundo* spp. during 1991 and 1992 in tobacco growing areas of Shimoga in Karnataka. The activities of birds were observed throughout the day. To quantify the intensity of birds damage, the observations were taken on ten randomly selected plants. The damaged leaves were collected plant position wise (viz., P, X, L and T, wherein 'P' refers to leaves at the bottom, 'T' refers to leaves at the top, 'X' and 'L' in between P and T). The extent of leaf damage was assessed on weight basis.

Results and Discussion

The birds *Acridotheres tristis*, *Acridotheres fuscus* and *Sturnus pagodarum* visited the tobacco fields during morning and evening hours. The birds entered the field only after the dew was cleared on the leaf surface which occurred around 9 a.m. depending on the weather. The first two species constituted 90 per cent of the observed bird population. *S.pagodarum* was less in number and was a shy predator. Birds visited the fields in two to three flocks. After feeding for 15–20 min. they used to move on to the bushes and cleaned their beaks for feeding again. Perhaps the gummy ooze on tobacco leaf necessitated beak cleaning. The birds perch on ground to pick up aphids present on the lower surface of the upper leaf. The damage caused by the claws was much more compared to the beak. One or two birds simultaneously were engaged in feeding on a single tobacco aphid infested plant. The moist soil clinging to the claws, soiled the leaf surface in addition to fecal matter.

From the Table 1, it is clear that the extent of leaf damage by birds is significantly high for middle leaves (X and L), compared to bottom (P) and top (T) leaves. It is important to note here that middle leaves are economically important for the manufacture of cigarettes. Though the damage is severe in 'X' and 'L' type of leaves, they differed significantly, that is there is almost 50 per cent difference in the amount of damage from 'L' to 'X' leaves. However, P and T recorded nonsignificant damages.

X, L and T position leaves had almost uniform population of aphids per unit area (VI Grade). The 'X' position leaves are broad with strong midrib facilitating the birds to alight on the leaves to feed on the aphids from the respective upper leaves. Thus, severity of damage was more in 'X' position leaves. The 'L' position leaves are narrower and resulted in less damage to that of 'X' position leaves. The 'P' position leaves had less number of aphids per unit area (III Grade) and leaves generally touched the soil, causing inconvenience to the birds in picking up aphids. 'T' position leaves were small and harboured good number of aphids (VI Grade), but unable to withstand the weight of the birds. Hence damage to 'P' and 'T' leaves was very low. In any position of the leaves, a certain percentage of aphids remained unfed by the birds.

Birds also acted as a mechanical transmitting agent of tobacco mosaic virus (TMV). *Hirundo* species was observed to fly continuously for hours together at a height of one to five meters, feeding on alate aphids. Thus, this study establishes perhaps for the first time predatory role of birds that affect the commercial product of crop plants like tobacco.

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Table 1 Tobacco leaf damage by birds while feeding on aphids (Position wise)

Plant Number	P		X		L		T	
	1991 — 1992		1991 — 1992		1991 — 1992		1991 — 1992	
1	3	3	34	26	13	10	3	3
2	2	2	32	28	12	11	4	4
3	3	3	33	24	13	10	4	4
4	3	3	31	25	11	8	3	3
5	3	3	30	26	13	12	3	3
6	2	2	33	24	12	10	4	3
7	3	2	34	26	10	10	3	3
8	2	2	32	27	13	10	3	3
9	2	3	31	23	11	10	3	3
10	2	2	30	24	13	11	3	3
Mean	2.5	2.5	32	25.3	12.1	10.2	3.3	3.2

Bird Predation on the Termite, *Odontotermes wallonensis* in Cultivated Tracts Around Bangalore

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The beneficial role of birds which devour mustard aphids, whitegrubs, castor semiloopers, cotton bollworms (Anonymous, 1992), and cardamom shoot-and-fruit borer (Chakravarthy, 1986), are well known. The House Sparrow, *Passer domesticus* reduced the population of polyphagous pest, *Heliothis armigera* by 40% in Kota, Rajasthan on wheat (Anonymous, 1992). In Ganapararam village, Guntur, farmers stopped spraying insecticides for control of insect pests. Instead the farmers erected perches to encourage insectivorous birds in their fields. The farmers estimated their total savings to be 1 million rupees since their expenditure for pesticides was about Rs.2500/ha. The pesticide free groundnut fields yielded well and were on par with insecticide sprayed plots (Anonymous, 1993).

Termite, *Odontotermes wallonensis* is a polyphagous pest infesting several crops during kharif (June-October) under rainfed conditions in red sandy soils. Observations in such cultivated tracts at South Bangalore were recorded from 1980 to 1982. Birds predating on termites were identified by a pair of 7 ± 35 binoculars. At each observation period, species and numbers of birds were recorded.

Eleven species, viz. Indian Myna, *Acridotheres tristis*; Jungle Myna, *Acrido theres fuscus*; Spotted Owlet, *Athene brama*; Common Indian Nightjar, *Caprimulgus asiaticus*; Jungle Crow, *Corvus macrorhynchos*; Drongo, *Dicrurus adsimilis*; Bee-eater, *Merops orientalis*; Pariah Kite, *Milvus migrans*; House Sparrow, *Passer domesticus* and Indian Robin, *Saxicoloides fulicata* were observed feeding on termites which emerged from soil during twilight hours between 6.30 to 9.30 hr.

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Birds Damage to Pineapple *Ananas comosus* in Coastal and Hill Regions of Karnataka

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Pineapple, *Annas comosus* L. (Merr.) is cultivated along borders of vegetable and fruit gardens in coastal region. Porcupine (*Hystrix indica*), Wildboar (*Sus scrofa*), Jackal (*Canis sureus*), Jungle Crow (*Corvus macrorhynchos*), Koel (*Eudynamys scolopacea*), Crow-pheasant (*Centropus sinensis*) and other birds depredate pineapple, sometimes incurring economic losses to farmers. In most situations in coastal region and in some situations in hill region, Jungle Crow was found to be the dominant species. On an average, it was estimated from a survey during 1991 to 1993 that pineapple fruit yield losses in coastal region amounted to 22% (n = 16) and 12% (n = 18) in hill region due to the vertebrate pests including birds.

The crows preferred well-ripened (6 months old) fruits but also attacked partially ripened ones (4 to 5 months old). A fruit was destroyed by a crow on an average on 12 min (n = 14). Subsequently the damaged fruits are rapidly prone to black or soft rot. The fruits lose market value and become unfit for consumption.

In order to protect the fruits from crow damage, a trial was laid out in Dharmastala, Ujjare taluk. The fruits were covered externally by a thatch of dry grass and leaves of the plant itself to prevent the crow from alighting on the plant. When the fruits became more than four months old, the rosette of spiky leaves was tied over 50 fruits, randomly. A set of another 30 fruits were covered with grass in the same pitch. Twenty fruits left uncovered, served as control. After three weeks, it was found that while 70% of uncovered fruits were destroyed, the fruits covered either by grass (none destroyed) or leaves (8% destroyed) remained comparatively unattacked. The practice of covering ripening pineapple fruits would help to minimize bird damage.

Pesticide Hazards to Non-target Birds

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Pesticide hazards to non-target animals are gaining attention worldwide in pursuit of developing narrow-spectrum and biodegradable pesticides. Evidences indicate that certain pesticides are more toxic to birds than to mammals of similar body weight. Several reports have revealed that acute rodenticides used in grain baits posed primary hazards to gallinaceous birds, waterfowl and many seed eating birds. This trend became more pronounced with anti coagulant rodenticides which also pose a serious threat to raptors due to their secondary toxicity. Insecticides like DDT(organochlorine) and Dieldrin have a greater capacity for bioaccumulation in birds and result in mortality and depressed reproduction (due to eggshell thinning and nestling poisoning). Carbamate and Organophosphate insecticides along with certain avicides like avitrol have devastating effects on birds both from primary and secondary toxicity. A wide variety of pesticides which are sprayed cause dermal toxicity in birds and impair their nervous system leading to disorientation and erratic behaviour before death.

There is also evidence that birds are deficient in certain enzymes which aid to detoxification of pesticides.

It has been observed that migratory birds carry pesticide residues to other ecosystems and poison their predators and/or cause reproductive failures, thus revealing a global impact of pesticide hazards.

Relative Susceptibility of Wheat Hybrids to Bird Damage

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Introduction

Birds damage wheat from sowing to sprouting, grain setting to harvest, in the threshing yard and storage godowns (Mehrotra and Bhatnagar, 1979). At sowing to sprouting control is possible with seed dressings using 0.025% Landrin and Methiocarb (Dolbeer *et al.*, 1979; Mehrotra and Bhatnagar, 1979 and Poche *et al.*, 1980). Methiocarb seed dressings in wheat and barely have also been shown to provide simultaneous control of sub-terranean cutting insects like *Gryllotalpa* spp. (Bhatnagar and Singh, 1982). Even use of metallised reflective ribbon, 70 cm above seed bed and at inter distance of 1.5 to 2.0 m. provides high efficacy as compared to its efficacy at grain setting to harvest. These appear quite safe to even protected and endangered or migratory birds many of which depredate sown and sprouting wheat fields (Mehrotra and Bhatnagar, 1979).

At grain maturity, no chemical spray provides significant protection against bird species like Quelea (DeGrazio, 1974; Dehaven and DeGrazio, 1974; Knittle *et al.*, 1971; Cunningham, 1974; Cunningham and Knittle, 1975). Similar situation exists in India against parakeets, sparrows and weaver birds. Obviously, alternative measures for integrating in bird damage control have to be developed. One such approach is to identify resistant or less susceptible varieties for use in habitat manipulation (cultivation in vulnerable regions in relation to bird abundance over crop). Previous studies from Bihar (Ambastha, 1959–60, and Bhatnagar, 1979 in Mehrotra and Bhatnagar, 1979) are not appropriate with development of newer hybrids/varieties of high yielding nature and other agronomical factors. With these objectives, studies were taken on eight new promising wheat hybrids during 1992–93. These are presented in this paper.

Material And Methods

A replicated field trial was taken on eight hybrids, namely, HD-2329, RAJ-1555, PDW-34, HD-4550, HD-4642, HD-4633, PDW-215 and HD-4640. Each of these were cultivated in large plots (7 × 15 m), with three replication for exposed, and three for partly protected with metallised reflective ribbon and paper bags. This layout was designed to provide wider exposure of each variety within larger plots. Along with these, each hybrid was cultivated in 30 m long rows (three for each cultivar) to provide multiple choice within short distance. The recommended agronomical practices (Tandon and Sethi, 1991) (without pesticide) were followed. Data are given in Table 1.

Results And Discussion

Data revealed that per cent yield output in unprotected plots vs. partly protected plots and index of susceptibility (figures in parentheses) ranged as follows: HD-2329 : 4.21 (95.79); RAJ-1555 : 23.45 (76.55); PDW-34 : 27. 94 (72.06); HD-4530 : 33.65 (66.35); HD-4642 : 56.13 (43.86); HD-4633 : 82.57 (17.43); PD-215 : 91.70 (8.3); HD-4640 : 97.85 (2.15). The study thus showed that most susceptible variety was HD-2329; moderately susceptible varieties were RAJ-1555, PD-34, HD-4530 and least susceptible varieties with yield output ranging from 56.13 to 97.85% were HD- 4642, HD-4633, PD-215 and HD-4640. Thus with manipulations or designing a layout in relation to abundance of depredatory birds from roost distance (Ambastha, 1959–60), reduction in bird damage with cultivation of less susceptible varieties appeared useful in integrating with control measures.

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Table 1 : Relative susceptibility of eight wheat hybrids to bird damage in un-protected (UN) and partly protected plots (PP), with average yield

Parameter (ave./plot of 4 replicates	Wheat hybrids							
	Hd-2329	Raj-1555	Pdw-34	Hd-4530	HD4642	HD-4639	Pdw-215	HD-4640
UN: Ave.yld /plot(gm)	9.96	53.3	99.38	67.58	84.2	210.0	144.8	390.0
PP: Ave.yld. /plot(gm)	236.48	227.29	355.59	200.83	150.0	254.32	157.9	337.2
% of yld out put from PP	4.21	23.45	27.94	33.65	56.13	82.57	91.70	97.85
Index of susceptibility (% of yld output - 100)	95.79	76.71	72.06	66.35	43.87	17.43	8.3	2.15

Depredation of Guava Fruits (*Psidium gujava*) by Birds at Mudigere, Chickmagalur, Karnataka

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At Mudigere guava fruits were found to be depredated by Jungle Crow, *Corvus macrohynchos*, Small Green Barbet (*Megalaima viridis*) and Parakeet (*Psittacula kramen*). Observations on number of unripened, partially ripened and fully ripened fruits damaged by birds revealed that the depredative loss and rate of depredation on guava varied depending upon the maturity of fruits. Birds destroyed, on an average, about 14 per cent unripened, 23.7 per cent partially ripened and 32.8 per cent fully ripened fruits (Table 1), there being significant and positive correlation (r = 0.2169) between the two. The rate of depredation on unripened, partially ripened and fully ripened fruits was 2-4, 2-3 and 3-2 fruits per day, respectively.

In order to reduce the bird depredation, that portion of the guave tree canopy was covered where fruits were exposed with dried grass, thatched materials and mat of dried leaves.

In an orchard of 600 trees, 25% of trees were so covered randomly. Weekly observations recorded on fruit depredation for one month showed that in protected trees the percent fruit depredation was 16.80% compared to 33.61% in unprotected trees.

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Table 1 : Bird depredation on Guava fruits at Mudigere

Date	Fruit (Nos) damaged/tree Unprotected			
	Unripened	Partially ripened	Fully ripened	Protected
11.08.92	10.55	25.55	30.25	11.05
15.08.92	20.50	32.50	45.95	16.49
19.08.92	10.55	35.45	50.25	16.04
23.08.92	20.25	15.25	35.45	11.82
30.08.92	18.75	25.35	32.45	12.75
08.09.92	16.35	20.35	17.58	9.04
16.09.92	18.25	19.75	30.45	11.40
24.09.92	10.35	35.25	43.75	14.89
02.10.92	8.35	12.35	20.35	6.84
10.10.92	6.25	15.45	22.15	7.30
Total	140.20	237.30	328.60	117.50
Mean	14.20	23.73	32.86	
% Loss		33.61		16.80
't' at 5%	8.87			6.07

Plastic Bagging for Controlling Bird Damage in Sunflower Heads

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Introduction

Sunflower is important for its edible oil (Sindagi and Virupakshappa, 1986). Bird damage at sowing to sprouting and at seed setting to harvest is high almost throughout the country (Mehrotra and Bhatnagar, 1979; Toor and Ramzan, 1974 and Dhindsa *et al.*, 1991). House Crows (*Corvus splendens*) alone were estimated to damage 65.1% in Punjab (Dhindsa *et al.*, 1991) at sprouting. At this stage, in other areas, Common Pigeons (*Columba livia*), Ring Doves (*Streptopelia decaocto*), Peafowls (*Pavo cristatus*) and migratory birds like Indian Crane, Demoiselle Crane and Sarus Cranes also depredate. Dhindsa *et al.*, (1991) have shown that seed dressings with commonly used fungicides, 0.5% Tetramethyl-Thiuram Sulphide and 0.5% Copper Oxychloride did not reduce damage by Crows. This can, however, be reduced with use of reflective tapes at 70 cm above seed beds at 1.5 m interdistance with double horizontal rows (upto height 1 m) on borders of plots.

Bird damage in crops at seed setting to harvest is well known throughout world (Dolbeer, 1975 and Besser, 1978). From India, excessive depredations in flower heads by 10 species of parakeets (out of 14) in different regions are known. The known control methods (Mehrotra and Bhatnagar, 1979) have not provided any efficacy. This led to the investigation on mechanical exclusion approach combined with scaring by use of reflective ribbon.

Material and Methods

Sunflower variety 'Morden' was cultivated in three large plots, each comprising of three sub-replicates of fifteen rows, each of 15 m length. Each of the replicates was at an interdistance of 70 m. Of these, six sub-replicates were selected at random and treated, as replicates were large plots. Data was recorded from commencement of bird damage when plastic bags were put on flowerheads and stapled at the stalk.

Plastic bagging involved use of ordinary plastic bags of 31.0 x 48.5 cm. These were punched with 7–8 rows of 6 x 11 mm holes, at an interdistance of 2.5 cm. Between rows of punched holes strips of metallised reflective ribbons in alternating colours (red and silver) were affixed with synthetic resin, Petrovis-100. This was done to combine scaring with bagging. Flowerheads were bagged after setting. Data are given in Table 1.

Results and Discussion

Study showed that average number of flowerheads in various replicates ranged from 33.33 to 101.73. This variation was due to complete loss of small matured flowerheads cut from stalks by parakeets. Thus average number of damaged flowerheads in six replicates ranged from 15.8 to 86.48 which on quantification to per cent damage ranged 26.34 to 95.31. None of the bagged flowerhead suffered damage.

Results indicated the combined effects of exclusion with bagging and behavioural scaring with affixed ribbon strips on the bags is economical in preventing bird damage.

Acknowledgement

Authors wish to thank the Director and Head of the Division of Mycology and Plant Pathology, IARI, New Delhi for providing facilities.

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Table 1 Relative bird damage in Sunflowerheads unprotected and protected with plastic bagging

Parameters	Replicates					
	R–1	R–2	R–3	R–4	R–5	R–6
Average number of flowerheads per row	101.73 (1526.0)	89.12 (1336.0)	90.33 (1355.0)	68.06 (1021.0)	33.33 (500.0)	43.06 (646.0)
Average number of damaged per row	86.86 (1303.0)	74.00 (1110.0)	34.13 (512.0)	17.93 (269.0)	17.60 (264.0)	15.80 (237.0)
% Damaged	95.111	83.034	37.78	26.34	52.80	36.68
% Bagged	Nil	Nil	Nil	2.86	5.51	4.31
Damaged in Bagged	NA	NA	NA	Nil	Nil	Nil

Figures in parentheses are on total numbers per plot

Effect of Cultural Practices on Jungle Crow (*Corvus macrohynchos*) Damage to Transplanted Paddy Seedlings in Hill Region of Karnataka

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Jungle crow, *Corvus macrorhynchus* Vielliot in transplanted paddy fields, remove seedlings immediately after transplanting, as a playful behaviour. Observation on the impact of playful behaviour on seedling loss was recorded. Depending on the growth, seedlings were categorised into 15 days old and 15 days old. There were significant differences in crow damage between the two groups of seedlings. Less than 15 days old seedlings suffered significantly more damage (29.70%) than older seedlings (2.40%) (Table 1).

The bird while disturbing the surface soil in search of earthworms, coleopterous and lepidopterous larvae and other soil fauna incidentally may cause economic loss of seedlings especially in small paddy fields (1 acre).

The effect of water level and age of the seedlings on Jungle crow damage on transplanted seedlings was studied. It appeared that paddy seedlings form a physical obstruction to search by crows. So, the birds habitually uprooted the seedlings. It was clear that higher seedling loss (98.80%) due to Jungle Crows was observed in paddy fields having no water. Fields with 3 cm water was free from crow damage. Maintaining the water level at 3 cm depth in paddy fields during transplanting therefore can minimise the seedling loss by crows.

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Table 1 Paddy seedlings uprooted by Jungle Crows in relation to the age of the seedlings and water levels at Mudigere during 1991–92

Paddy field	Seedlings (per cent) uprooted				
	Age of seedlings		Damage in relation to water level		
	15 days old	15 days old	Without water	3 cm standing water	3 cms water
1	9.60	1.60	100.00	30.50	0.0
2	14.40	4.00	98.00	24.60	0.0
3	44.30	2.50	99.50	22.40	0.0
4	41.50	1.70	98.90	20.90	0.0
5	47.70	0.80	96.80	25.00	0.0
6	20.70	3.60	100.00	28.00	0.0
Mean	29.70	2.40	98.80	25.20	0.0
C.D. at 5%	3.93			6.75	

Effects of 4-Aminopyridine on Vultures

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Introduction

Whitebacked Vulture, *Gyps bengalensis* Linnaeus is a well known scavenging bird (Ali, 1972). At times droppings of the bird from monuments and avenue trees become a nuisance (Bhatnagar, 1976). It is now recognised as a problematic bird in aviation (Agarwal and Bhatnagar, 1984a & b 1 & 2 and Bhatnagar, 1985). Among the incidents of bird aircraft collisions, nearly 58 per cent cases are due to vultures in India (Rao, 1984 and Barnwal, 1984). So In this context a study on the effect of 4-aminopyridine N-oxide on Whitebacked Vulture was initiated.

4-aminopyridine is an acutely toxic substituted pyridine reported to cause various clinical signs that commence with hyperexcitability. The initial effects are noted usually in 10–15 minutes (at doses near LD_{50}). Death occurs within 15 min to 4 hours (Schafer *et al.*, 1973). In birds the compound produces pronounced behavioural responses in many gregarious avian species (Goodhue *et al.*, 1964) like disoriented behaviour and emitting of distress cries. This frightens untreated birds (Flynn, 1965; Goodhue and Baumgartner, 1965 a & b — 1 & 2). This led to the selection of the compound for testing on vultures.

Material and Methods

In the study live birds were trapped from Timarpur Sanitary Land Fills by the method described by Bhatnagar *et al.*, 1964), and were maintained in large ($2m^3$) cages for acclimatisation (Agarwal and Bhatnagar, 1984). During acclimatisation water and dressed buffalo meat were provided. Tests were carried out on two individuals to avoid unwanted mortality. The treatment comprised of 500 g of meat with 75, 100, 125, 150 and 175 mg of 4-Aminopyridine N-oxide for five days separately for each treatment. The data are given in Table 1.

Results and Discussion

The details results are in Table 1.

Lethal symptoms were noticed on 21st day when given 4-Aminophyridine @ 350 mg/kg meat. These commenced with blood vomit and death resulted after two days.

The studies have indicated that 4-Aminopyridine baits markedly affected the behaviour of Whitebacked Vultures and affected responses comprised of increased body movements, pronounced wing flapping and wing closing, scratching and preening, tendency to drink water frequently and restlessness in comparison to untreated birds. These hyper activities are important negative responses to soaring which involves balanced behavioural interaction with meteorological conditions especially the thermals. The data indicated that treated birds were not expected to fly and soar to pose any hazards to aviation. The chemical is apparently tolerated at subacuted chronic levels over extended periods (Holler and Schafer, 1982). Further field tests for practical utility is recommended.

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Table 1 Comparison of different behavioural responses of vultures/10 min/observation, at different concentrations of 4-aminopyridine with normal behaviour under caged conditions

Behavioural parameter	Experimental bird			Control bird		'Paired' test at p=0.05 Exp. Bird vs. control	'Paired t' test at P=0.05 for different con.
	Conc. of 4-Amino-pyridine/kg of meat	X_1 average	S.D. (Standard Deviation)	Average	S.D. (Standard Deviation)		
Body movements	75 mg	6.60	3.37	7.20	6.57	0.18 N.S.	75 mg vs. 100 mg; t = 2.528*
	100 mg	13.80	5.44	7.20	6.57	1.73 N.S.	125 mg vs. 150 mg; t = 2.35*
	125 mg	10.60	3.43	7.20	6.57	1.07 N.S.	150 mg vs. 175 mg; t = 0.19 N.S.
	150 mg	5.20	3.83	7.20	6.57	0.60 N.S.	
	175 mg	6.20	2.58	7.20	6.57	0.34 N.S.	
Flying attempts	75 mg	7.00	4.90	0.20	0.44	4.02x*	75 mg vs. 100 mg; t = 0 N.S.
	100 mg	7.00	6.80	0.20	0.44	2.96*	125 mg vs. 150 mg; t = 0.25 N.S.
	125 mg	7.00	7.03	0.20	0.44	2.88*	150 mg vs. 175 mg; t = 2.5*
	150 mg	6.20	2.77	0.20	0.44	5.92*	
	175 mg	2.20	2.38	0.20	0.44	2.32*	
Wing spaning	75 mg	6.60	4.70	1.20	2.03	2.53*	75 mg vs. 100 mg; t = 1.32 N.S.
	100 mg	2.80	4.30	1.20	2.03	0.80 N.S.	125 mg vs. 150 mg; t = 0.76 N.S.
	125 mg	3.80	3.69	1.20	2.03	1.38 N.S.	150 mg vs. 175 mg; t = 0.75
	150 mg	5.80	4.38	1.20	2.03	2.27x pL.0.25	
	175 mg	8.20	5.60	1.20	2.03	2.48*	
Preening	75 mg	2.80	4.38	0.20	0.44	1.70 N.S.	75 mg vs. 100 mg; t = 0.71 N.S.
	100 mg	1.20	2.60	0.20	0.44	1.03 N.S.	125 mg vs. 150 mg; t = 1.98 N.S.
	125 mg	1.20	2.04	0.20	0.44	2.03 N.S.	150 mg vs. 175 mg; t = 2.39*
	150 mg	5.60	4.03	0.20	0.44	3.82**	
	175 mg	1.20	1.78	0.20	0.44	1.42 N.S.	

'Watch and Ward' : A Tool for Protecting Orange Fruits from Bird Damage

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Mandarins (*Citrus sinensis*) are cultivated in the hill region of Karnataka along with coffee as an intercrop. Fruit losses due to birds is one of the important constraints for the growers. About 50–55% fruit losses was assessed due to Jungle Crow (30%), Small Green Barbet (10%), Bluewinged Parakeet (5%), Chloropsis (3%) and others viz., Coppersmith, bulbul, thrush, etc. (4%). Jungle Crow was the most dominant in depredating orange fruits. Crow damaged the fruits by making circular cuts on the skin to feed on the internal contents, leaving empty or hollow skin intact with plant or detached. Other species of birds also makes a small irregular hole for feeding on fruits intact on the plant.

Watch-and-ward was evaluated as a means of protecting oranges by employing a trained scarer to move around the plantation for about 6–8 hours a day, using crackers and tin rattling. In the control plots, 2.5 km away where bird species composition was similar, no watch-and-ward was maintained. Watch-and-ward lasted for 35 days. Management practices were carried out to reduce the fruit loss due to different bird species by watch-and-ward at Cholikere Estate, Mudigere (17° 7', 29", 75° 37' 35") during 1992–93. At weekly intervals, fruits damaged per tree were counted and finally fruit loss/tree was expressed in terms of percentage.

On an average, 178 fruits/tree/week were damaged by Jungle Crow and 64 fruits by other birds in the plot where no watch and ward was carried out, while 60 fruits/tree/week were damaged by Jungle Crow and 31 fruits by other birds were damaged in the plot with watch-and-ward. Jungle crow preferred fully ripened fruits and other birds preferred about to ripen or even light yellow coloured fruits.

By watch-and-ward, average fruit damage could be prevented by about 66.29% from Jungle Crow and 55.57% from other birds (Table 1).

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Table 1 : Effect of Watch-and-ward and ward on mandarim loss due to different species of birds at Mudigere

	No. of fruits loss/tree*			
	Jungle Crow		Other birds	
date	a	b	a	b
22.01.93	10	7	4	3
24.01.93	12	3	5	2
28.01.93	15	5	6	2
02.02.93	18	4	7	2
06.02.93	20	3	8	2
10.02.93	15	2	9	2
14.02.93	12	2	6	1
18.02.93	14	3	5	3
232.02.93	15	4	4	2
26.02.93	16	10	3	2
30.02.93	17	9	2	3
10.03.93	14	8	5	4
Total	178	60	64	31
% Loss reduction	66.29		57.57.	

* = n = 10 trees
a = Without watch and ward
b = With watch and ward

Watch-and-Ward : A Method for Preventing Bird Damage on Sunflower

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Birds damage to Sunflower at Bukkasagara of Kadur taluk was recorded from 13.7.1992 to 1.9.1992. Twenty five, fifty and hundred per cent damaged sunflower heads were counted in 'watch-and-ward' and without watch-and-ward fields. The seed depredation is expressed in terms of percentage damage to sunflower heads. Parakeet (*Psittacula krameri*), Jungle Crow (*Corvus macrohynchos*), House sparrow (*Passer domesticus*); Spotted Munia (*Lonchura punctulata*), Blackheaded Munia (*Lonchura malacca*), Baya weaver (*Ploceus phillippinus*) were the important birds observed feeding. Many species of birds prefer sunflower seed because it helps in growth, moult, fat storage and weight maintenance (Besser, 1978).

The number of sunflower heads lost per acre due to birds was 416.7, 341.6 and 245.1 in 25, 50 and 100 per cent heads damaged, respectively in fields 'without watch-and-ward.' In 'watch-and-ward' fields, the number of sunflower heads loss/acre was 325.9, 253.1 and 153.9 in 25, 50 and 100 per cent heads damaged, respectively. Total sunflower heads loss due to birds without watch-and-ward was 1003.8/acre. In watch-and-ward field the loss could be prevented upto 731.9 heads/acre (Table 1). 28.3 per cent loss due to birds can thus be prevented by watch-and-ward for 30 to 40 days of the crop at head stage.

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Table 1 : Birds damage to sunflower at Bukkasagar of Kadur taluk, 1992–93

Dates	Sunflower heads (Nos.) damaged/acre					
	Percent of heads damaged					
	25		50		100	
	a	b	a	b	a	b
13.07.92	35.8	32.4	25.4	15.3	15.2	10.2
18.07.92	36.3	35.0	23.3	18.4	18.2	11.2
28.07.92	37.5	15.8	22.8	22.5	22.5	15.9
12.08.92	38.8	22.5	18.8	19.3	18.5	10.5
13.08.92	39.8	25.2	35.3	19.8	25.5	8.5
14.08.92	42.3	42.8	42.8	35.3	32.6	19.5
24.08.92	45.8	33.3	45.3	23.8	33.5	25.0
25.08.92	45.3	32.8	48.8	24.4	32.8	15.8
26.08.92	49.8	40.3	40.3	36.3	25.5	20.5
03.09.92	45.3	45.8	38.8	38.0	30.8	15.8
Total	416.7	325.9	341.6	253.1	245.1	152.9
% loss reduced by watch/ward	21.39		25.91		37.62	

a = Without watch - and - ward

b = Watch - and - ward

Relative Susceptibility of Maize Hybrids to Bird Damage

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Introduction

Maize is known for its susceptibility to parakeets. Some of the hybrids of Deccan and Ganga series are less susceptible due to tightness of spathes over cobs. This has significance in developing integrated bird management. The scare-reflective ribbons and manual scaring are either poor in efficacy or are expensive. Use of 6 mm wide rubber bands (cut from old bicycle tube) affixed over cob (Mathur, 1993) and wrapping of leaf over cobs to camouflage it (Dhindsa *et al.*, 1992), pose their own limitations. Therefore, to invite attention of ornithologists and breeders this study was undertaken.

Material and Methods

Field observations were taken in replicated trial with various hybrids, cultivated in random blocks/plots, having 5 rows each 3 m in length. The recommended agronomical practices without any pesticidal treatment at any stage were followed. For convenience, the hybrids were put in three sets comprising of 49 hybrids. Amongst these, observations were recorded on hybrids showing noticeable differences, *viz.*, 16 in set-1, 25 in set-2 and 18 in set-3. Visual observations were taken on percent damage and on damaged cobs and spathe arrangement as seen from the stand side of a cob. The data are discussed.

Results and Discussion

Observations revealed that it is hard to correlate spathe structure and configuration other than its tightness and coverage over the cob. With these a simple categorisation as less or lesser susceptible, moderately susceptible and susceptible hybrids is feasible under three sets. Relative susceptibility under different sets ranged as follows:

Set-1 : Average per cent damage ranged from 0.0 to 75.0 and hybrids Piralo Piraciba and D-Composite sustained least damage. In the former, the spathe covered less than half the length of cob and first inner spathe covered whole length of the cob. In the latter, outer spathe covered more than half the length of the cob and laterally covered nearly the whole cob width. Thus even two spathes provided double covering. The most susceptible hybrid was Ganga Safed-2 with 75.0 per cent loss. In this susceptibility may due to biochemical features of grain and outermost spathe covering less than half the cob length with laterally no cover for the whole cob width upto the tip. Other susceptible hybrids were C.B.W.R., Comp × 1, Deccan-1, Mandi Comp 1 C4; Suwan DMR Source-8; Phil DMR Comp × 3; Syn. Eslaq Hv.-1; Gautemala DMR and CPCA Var-2. Amongst these, average per cent damage, respectively were 27.27, 28.57, 33.33, 33.3, 37.5, 42.86, 44.44 and 62.5%. In these two basic type of spathe structuring was observed: (i) outer spathe covering half the cob length and (ii) outer spathe covering less than the half the cob length. Hybrid of intermediate degree of susceptibility were Thai Comp × 4; Suwan DMR Source-10; Suwan DMR Source-1 and Hybrid Comp DMR in which average per cent damage was 6.15; 14.29; 14.0 and 11.11, respectively. In these hybrids too, outer most covering was more than the half the length of cob.

Set-2: The average per cent damage was 66.67 and the least susceptible hybrids were Khyber x Sarhad, CB × Syn. Early Local Malkapur and Swahi White x Sarhad. These did not show any damage. Here, the spathes covered upto cob tip in straight flaps, and laterally also covering the cob. In hybrids of low range susceptibility (1.0 to 16.67%) the spathes overlapped outer most which nearly covered half the length of cob, as in Sadaf (12.5%), BS-8 (16.67%) and Sarhad (16.67%).

In hybrids of higher susceptibility the spathe structuring comprised of two types. In varieties having outer most covering nearly upto tip of cob, as in VaCB ×2 ?; PI-311240 × Sarhad; Dentado Comp Blanco (has keeled outer spathe but is loose); KCE (F); Suwan-1 (has loose outer spathe and (OH × 545 × FR-3) × (FR 4-A × FR-4-C) × Sarhad. These, respectively, sustained depredations of 66.67%; 30.0%, 60.0%, 75.0%; 25.0%; 60.0% and 54.55%. Hybrids having outer spathe covering nearly half the cob length had per cent damage 28.57%; 66.67%; 41.7%; 40.0%; 66.67% and 25.0%, respectively, in IA-2 EAR Syn.; Zia; Sadaf × Sarhad (has loose outer spathe); CBW-1; KCA (FT) and CBWR-Comp.

Set-3: It comprised of comparatively less susceptible hybrids in which damage ranged upto 26.0 per cent. Of these the least susceptible were Var. Sc. 48-A; Antigua-Gr-1; Early DMR Comp-2; Suwan DMR Source-2; (Thai Comp-1 × DMR) × (DMR Punjabman); Yurpo 60-B F-3 and USDA-I 21873. These did not sustain any damage and had two types of spathe configuration, i.e. outer most covering more than half the cob length and those having outer most spathe covering less than the cob length. Highly susceptible hybrids were Syn.550; Phil DMR Comp-2; Early DMR Comp-1, etc.

The study indicated the need for further observations on spathe structuring/configuration in relation to bird damage, besides biochemical properties of grains in different popular hybrids in the country. These results are expected to be of use to breeders in development of 'resistant hybrids'.

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Behavioural Responses of White Backed Vulture (*Gyps benghalensis*) to Coloured Lights

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Introduction

One way of reducing bird-hits to aircrafts could be to distract or 'guide away' birds from flyways of aircrafts. This could be achieved by affecting phototactic responses as phototaxis is governed by light in specific wavelengths or by exposing birds to intolerable wavelengths of energies. However, hitherto phototactic responses on Indian Whitebacked Vultures are not known. Studies were, therefore, warranted as the species is largely involved in bird aircraft strike hazards in India.

Material and Methods

Individual birds were maintained in iron cages (5 cu ft) at the IARI laboratory. These were exposed to 1000 C.P. Halogen tube light ("Movie Light") with coloured tissue papers affixed in front. Each cage was covered, except the front, with thick black cloth.

In all cases responses to lights were studied in comparison with sunlight. The orientation behaviour had parameters, given in Tables 1 and 2.

Results and Discussion

Based on this preliminary investigation, it is suggested that light source of 1000 watt may cause no appreciable difference or changes in visual behaviour of vulture. The paired 't' test revealed non-significant differences in all treatments (Table 1).

Under non-visual behavioural responses of vultures to coloured lights (Table 2), differences were not large enough to produce any significant difference in the choosen behavioural parameters.

It is concluded that varying phototactic responses warrant studies with higher intensity source.

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Table 1: Orientation responses of white backed vultures to coloured lights

Pairs of light tested		Mean* frequency of									
		Eye blinking		Neck movements				Kinosis		Taxis	
				Right		Left					
		I	II	I	II	I	II	I	II	I	II
1.	White and sun light	4.55	4.38	4.31	2.88	4.16	1.85	9.19	N.R.	1.83	N.R.
2	Whie and sun light	4.47	4.33	4.37	3.36	4.02	2.44	6.83	1.36	7.01	1.40
1.	Blue and sun light	4.52	2.17	4.90	1.94	4.28	1.56	9.13	1.52	7.94	1.32
2.	Blue and sun light	4.48	4.26	3.65	3.66	3.03	3.26	7.04	1.40	2.44	0.48
1.	Red and sun light	4.70	4.85	4.07	3.33	4.25	2.86	1.87	0.62	1.87	0.62
2.	Red and sun light	4.70	4.33	4.40	3.70	3.70	2.94	3.39	1.13	3.56	1.18
3.	Red and sun light	4.62	4.22	4.09	2.21	4.39	4.33	5.26	0.87	4.53	0.90
4.	Red and sun light	4.52	4.33	3.30	4.01	3.69	3.57	2.44	0.81	4.31	1.40
1.	Green and sun light	4.70	4.26	4.55	4.25	4.64	4.54	9.90	3.30	1.20	0.40
2.	Green and sun light	4.48	3.97	2.75	3.38	3.21	3.33	2.44	0.81	4.31	1.43
3.	Green and sun light	4.22	4.10	3.31	3.88	2.72	4.63	4.67	1.55	2.44	0.81
4.	Green and sun light	4.26	4.05	3.71	3.97	3.15	4.07	3.09	1.03	2.54	0.84
1.	Yellow and sun light	4.21	3.97	4.73	3.83	4.30	3.98	1.22	0.40	4.92	1.64
2.	Yellow and sun light	4.26	4.01	4.34	4.31	4.16	4.26	2.80	0.93	Nil	Nil
3.	Yellow and sun light	4.14	3.97	3.92	3.88	3.79	3.92	N.R.	N.R.	N.R.	N.R.
4.	Yellow and sun light	4.44	4.10	3.96	3.03	4.76	3.65	N.R.	N.R.	N.R.	N.R.

I, II correspond to the birds exposed to the first and second lights, respectively.

* Mean of ten observations/day.

For all pairs combinations at 0.05 level, t - value non-significant.

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Table 2 : Non orientational behavioural responses of white backed vultures to coloured lights.

Pairs of light tested		Mean frequency							
		Flapping		Preening		Scratching		Wing spanning	
		1	2	1	2	1	2	1	2
1.	Blue light and sun light	0.69	1.69	1.15	0.58	0.52	0.00	0.40	1.20
2.	Blue light and sun light	0.40	0.62	1.83	3.97	0.00	0.40	0.00	0.91
1.	Red and sun light	0.00	1.18	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.
2.	Red and sun light	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00
3.	Red and sun light	0.00	0.00	0.00	0.00	0.00	0.40	0.00	1.11
4.	Red and sun light	0.00	0.00	2.28	0.00	0.00	0.00	0.00	0.62
5.	Red and sun light	0.00	0.40	0.78	0.00	0.00	0.00	0.00	0.40
1.	Green and sunlight	0.00	1.55	0.00	2.58	2.58	4.62	0.00	0.00
2.	Green and sunlight	3.21	3.33	0.00	1.05	1.05	4.25	0.00	0.40
3.	Green and sunlight	2.72	4.63	0.00	0.81	0.81	1.60	0.00	0.00
4.	Green and sunlight	3.15	4.07	0.40	1.55	1.55	4.40	0.00	0.00
1.	Yellow and sunlight	0.30	4.40	0.80	0.00	0.00	0.40	0.00	0.40
2.	Yellow and sunlight	0.30	1.46	2.83	0.40	0.40	0.00	0.40	1.43
3.	Yellow and sunlight	0.00	1.53	2.78	0.00	0.00	0.00	0.00	1.37
4.	Yellow and sunlight	0.00	0.52	2.91	0.00	0.00	0.40	0.40	0.78

1, 2 correspond to the brids exposed to the first and second lights, respectively.

* Mean of ten observations/day.

For all pair combinatins, t at 0.05 level, non-significant.

Cultural Tool for Bird Pest Management in Sorghum (*Sorghum vulgare*)

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Grain losses in Sorghum (*Sorghum vulgare*) due to bird depredation often reach economic levels in Chickmagalur. Birds, viz., Roseringed Parakeet (*Psittacula krameri*), Jungle Crow (*Corvus macrorhynchos*), House Sparrow (*Passer domesticus*), Spotted Munia (*Lonchura punctulata*), Blackheaded Munia (*Lonchura malacca*), Baya Weaver (*Ploceus phillippinus*) were observed with a pair of binocular (8 x 30) feeding on sorghum. In order to study the damage of birds in protected and unprotected sorghum earheads, an experiment was conducted at Sakrepatna in 0.1 acre. To cover flag leaf and dried sorghum leaves were used. Another sorghum plot one km apart with earheads uncovered, served as control. Observation on bird feeding were recorded for 15 days.

Birds damage on sorghum earheads was expressed as earheads damaged/acre.

Results showed that 35.97 per cent earheads could be saved by covering (Table 1).

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Table 1 : Bird damage to CSH-5 Sorghum at Sakrepatna

Date	Earheads (Nos.) damaged/ac. (n = 10)		
	Unwrapped	Wrapped	(% earheads save by wrapping)
13.07.92	43.92	30.44	30.69
18.07.92	41.64	18.44	55.71
25.07.92	68.12	19.32	71.63
08.08.92	66.24	16.64	74.87
14.08.92	99.64	20.32	79.60
24.08.92	59.12	20.64	65.08
30.08.92	46.32	20.00	56.82
08.09.92	48.92	15.64	68.03
16.09.92	35.24	19.32	45.18
23.09.92	42.72	14.00	67.22
30.09.92	36.72	17.00	53.70
Total	588.60	211.76 —	
CD at 5%	7.0		$\bar{x}$ = 35 .97

Sunflower (*Helianthus annuus* L.) Crop Depredation by Pigeons and Doves (Columbidae : Aves) in Karnataka

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A number of granivorous birds damage ripening sunflower (*Helianthus annuus* L.) world over (Seiler and Rogers, 1987). In India, Roseringed Parakeet (*Psittacula krameri* Bechastein) by its ubiquitous abundance and wasteful feeding habits is considered the most destructive pest on sunflower (Ali and Ripley, 1983). In many areas, bird damage is one of the main factors affecting the profitability of sunflower crop (Deodikar *et al.*, 1968). However, doves are known to glean only spilled grain in stubble, weed and cultivated patches because the birds are essentially ground feeding granivores. As also the pigeon, *Columba livia* that causes damage to newly sown sunflower seeds. In this paper, the damage done by pigeons and doves to sunflower crop is reported.

During June-July, 1990 to 1993, observations on feeding by pigeons on newly sown sunflower seeds in four acres, at GKVK farm campus of the University of Agricultural Sciences, Bangalore were recorded. The number of sunflower seeds removed to the total number present in 20, randomly selected 3 × 3 m or 4.5 × 3.0 m plots/year was recorded to get percentage seed loss. Pigeons foraged fields during morning (6.30 a.m. to 8.30 a.m.) evening, (4.30 p.m. to 6.30 p.m.) or during hours of no human activities. Data on seed loss was recorded three days after sowing. Bird sighting, presence of guano and plume feathers were confirmatory pointers to the pigeon feeding on sunflower seeds.

While on a survey of sunflower fields for vertebrate pests at Sakrayapatna (13° 22' N Lat., 76° 01' E, 754 AMSL) Chickmagalur, the Western Turtle dove (*Streptopelia orientalis meena* Sykes) was found feeding on sunflower during October, 1990. The variety Morden was grown in 0.5 ha in red sandy soils. The sunflower field was surrounded by coconut (*Cocos nucifera*), sugarcane (*Saccharum officinarum*) and mulberry (*Morus alba*) fields bordered with tall trees of various species. Turtle doves began feeding on sunflower three weeks before harvest. So, during early October, observations with 8 × 30 binoculars were recorded on number, feeding rate and feeding bouts throughout the day.

At Bangalore (12° 58'N, 77° 35'E, 921 m AMSL) observations with 8 × 30 binoculars were recorded on Spotted dove (*Streptopelia chinensis* Gmelin) feeding on sunflower at Main Research Station, University of Agricultural Sciences, Hebbal. Sunflower crop for seed production with CMS –234 A (female parent) and RHA-6D-1 (male parent) in 3:1 was sown on 27 February, 1992 in 0.25 ha on red sandy soils. The fields were located adjacent to a mixed thicket of Bamboo + *Acacia* from which doves could get unrestricted access to sunflower. At both locations, estimation of seed yields, losses due to doves feeding, damage on sunflower were made by a product of three parameters viz. number of feeding bouts, size of feeding bouts and feeding rates. The t-Test was used to seperate significant means.

The average flock size of pigeons in the sunflower plots was six (n=15) during the three years. The feeding was highly localised and damage was restricted to few patches. The birds foraged in flocks and were found digging out mud along rows to remove seeds. The average seed loss recorded for 1990–91, 1991–92 and 1992–93 was 1.8%, 2.3 and 1.2%, respectively. Seed loss by pigeon was observed to be more two days subsequent to rains than the day after rains. Pigeons preferred to forage rainfed sown plots compared to the very wet or irrigated plots. Although, in the present study the seed loss was negligible, pigeons in large flocks can cause considerable local damage to seeds.

The feeding patterns of both species of doves on sunflower consisted of pecking, grasping the seed, mandibulation (process by which seed is moved from the beak-tip to the buccal cavity) and swallowing. At milky stage (70–80 days old) doves perched on thalamus (back of head), removed peripheral portion of rind bit-by-bit first and then pecked on seeds. At maturity stage (90–100 days old) doves directly extracted seeds from heads. The turtle doves at Sakrayapatna generally pecked on sunflower from 6.15 a.m. to 10.30 a.m., 11.00 a.m. to 12.00 noon and from 12.20 p.m. to 6.15 p.m. In Bangalore, Spotted doves generally pecked on head from 6.30 a.m. to 9.00 a.m., 10.20 a.m. to 12.50 noon and from 2.15 p.m. to 6.20 p.m. So feeding in doves occurred intermittently in bouts interrupted by activities like scan and preen. Continuous observations through binoculars revealed that not all pecking was followed by mandibulation nor mandibulation was inevitably followed by swallowing.

Details concerning numbers and feeding of Turtle and Spotted Doves are given in Table 1. With feeding rate of 9/min, 121 bouts, feeding bout period of 4.5 min. and 14 birds on an average/0.5 ha, Turtle Doves population/day devoured about 38,000 seeds at Sakrayapatna. The doves were observed for three weeks on sunflower. So, the Turtle Doves removed, an estimated 760,000 seeds, weighing (@ 100 seed weight = 0.5 g) about 38.0 kgs. Similarly with feeding rate of 0.25/min., 110 bouts and on an average, 20 birds/0.25 ha, Spotted Dove population/day devoured 49,500 seeds at Bangalore. So the doves removed, an estimated 939,500 seeds, weighing (@ 100 seed weight = 3.5 g) about 32.88 kg. The amount devoured represented 18 per cent and 25 per cent of the total yield, respectively by Turtle and Spotted Doves (@ 10 q yield/ha in Sakrayapatna and 8 q yield/ha in Bangalore). While

feeding, generally the doves seldom allowed spilling of seeds. Instead the doves accumulated seeds in buccal cavity to feed at perch.

Turtle and Spotted Doves are known to glean only spilled grains/seeds of paddy, sorghum and other cereals, lentils and pulses, grasses and weeds (Ali and Ripley, 1983). However, observations reported here established that doves caused economic losses to sunflower by feeding on standing crop. This is because, as Zeigler (1976) noted doves possess a great flexibility in feeding behaviour pattern that play an important role in animal's adaptation to metabolic and environmental demands. Scaring, timely harvests and watch-and-ward would reduce doves depredation on sunflower.

Acknowledgements

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Table 1: Numbers and Feeding details of Doves on Sunflower

Bird species	Numbers per 0.5 ha (n=20)		Mean pecking rate/min on head (N=14)	Mean size (min) of feeding bout (n=14)	Mean no. of feeding bouts/day (n=14)
	Mean	maximum			
Western turtle dove	14	30	9.00	4.5	121
Spotted dove	40	56	8.25	3.3	110
Calculated t at 5%	11.40		N.S.	N.S.	N.S.

(Mean of observations at Sakrayapatna and Bangalore)

Eco-bio-Control of Pest And Nuisance Birds at Agriculture Farms Urban Areas Land Aerodromes in Western Rajasthan Thar Desert

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Many species of birds are commensal with man and have become serious pests to agriculture and nuisance in urban areas. This problem was studied for the last 25 years from 1967 to 1993 in western Rajasthan Thar desert, Jodhpur division, with special reference to their eco-bio-control.

The House Sparrow and the Blue Rock Pigeon are the most serious pests at agriculture farms particularly at barns and granaries. Covering of grain heaps is effective practice against depradation by birds and rats. It was observed that keeping of domestic cat and dog significantly scare and check invasion of pest birds at barns and granaries. As rural people protect and feed the sparrow and pigeon with religious sentiments, these have multiplied. This practice should be abandoned by villagers to reduce the population and nuisance.

As the peafowl enjoys rigid protection and generous feeding by villagers, it has also multiplied and become a serious pest to agriculture. The domestic cat and dog considerably check invasion and population of this.

At food-grain shops and markets and flour-mills where the House Sparrow and the Pigeon are serious pests, thread-net of small mesh over heaps of food-grains considerably check invasion birds, besides rat and squirrel.

Urban people negligently dump leftovers in open, that has highly increased the population of the House Crow and the Pariah Kite, which are serious robbers of edibles at Railway stations and bus- stands. It was observed that wide shed at such sites prevent air- raids of these birds.

Whitebacked Vulture, Long billed Vulture and Pariah Kite are serious nuisance at aerodromes as serious hazard to flight safety. The vulture soars around the aerodromes in search of carcases or to enjoy warm thermal winds. Strict prohibition of dumping of municipal carcases around 15 km radius of the aerodrome considerably reduced the soaring of the vulture. Offals of restaurants and meat-shops near aerodrome encourage hovering of the Pariah kite and the House crow; strict restriction against such practices have been found effective in reducing the kite near the aerodrome.

The Blue Rock Pigeon is serious nuisance near air terminal buildings and hangers of aerodromes as it haunts projections and clefts to buildings. Reduction of projections and clefts of buildings, may considerably reduce haunting of the pigeon.

The Little Egret is serious nuisance to flight safety at Jodhpur aerodrome. The Egret frequent the sewerage and pool near the aerodrome. Covering of the sewerage and eliminating formation of seepage pool has been suggested to concerned authorities to reduce the nuisance of the egret there and it is being followed.

Preliminary Observations on Factors Governing the Selection of Wintering Sites by Barheaded goose (*Anser indicus*) in Karnataka, India

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Introduction

The Barheaded Goose (Anser indicus) belongs to family Anatidae which includes all true waterfowl. There are 34 species of geese in the world, eleven of which are found in Asia and five of these have been recorded in India. Barheaded Goose breeds in the high mountains of Tibet, Central asia (from Tien Shan to Koknonur) and Ladakh (India). Birds ringed in Kirghiz of Russia during the breeding season have been recorded in Gilet of Pakistan (Chaudhry 1991) It is the only Indian goose whose breeding range, includes Ladakh (Table 1). The other four goose species visit India only during the winter months.

Goose play an important role in environment; where they occur in good numbers, they influence the ecology of the vegetation on which they forage.

The population of the species is estimated to be in the region of about 50,000 birds, and has been suggested to be a likely candidate for the list of globally threatened species (Perennou *et al.*, 1993).

A five year survey of the wetlands of Karnataka, in peninsular India, has revealed twenty important wintering areas for the Barheaded geese (Table 2).

Material and Methods

Since 1988, select wetlands were surveyed from 10 to 25th January every year, as part of Mid-winter Waterfowl census being coordinated by Asian Wetland Bureau (AWB), Malaysia and International Waterfowl and wetlands Research Bureau, Slimbridge, United Kingdom. Wetlands were covered by foot and the waterfowl were counted using a pair of 8 × 40' binoculars. The counts were recorded using standard forms, by volunteers (NGO's) who visited the same wetlands every year. Count data were analysed by the co-ordinators and circulated to all participants by IWRB/AWB.

Results and Discussions

In Karnataka (Fig.1), the Barheaded geese, frequent outlying wetlands of the rivers:- Krishna and Bheema in the Northern part of the state; Tungabadra, Varada and Dharma in the Central region; Kaveri and Arkavathi of South and South interior Karnataka.

The river basins and rainfed wetlands with vast sand bars, outlying these rivers are used by the Barheaded geese for resting during the day time. They also frequent medium sized wetlands surrounding paddy fields. The birds forage in paddy fields during the night for feeding on the crops. Their migration coincides with the paddy harvest season in Karnataka, during January to March.

Since there is an annual variation in the number of geese recorded in the state, there is a need to understand the likely causes for this. A study needs to be undertaken that will identify the most important sites, examine the temporal changes in the population at major sites, behavioural information that addresses feeding, roosting and other habits of the geese. Interactions of humans and geese also need to be addressed. It is envisaged that information gained by such a study can be used to address management issues related to conserving these sites for geese and other waterfowl.

Behavioural Responses

There are many other apparently suitable areas in the state, but they are not preferred by the geese. Reasons include hunting and disturbance of habitat, extension of agriculture upto the margin of wetlands, there by limiting the visibility range and recognition of enemy in time. Hunting and trapping is reported in nearly 67% of the 338 wetlands surveyed in Karnataka (Sridhar 1992).

Experiments on behavioral responses have revealed that different species clearly respond to the same or similar enemies, including man, in many different ways (Edwards *et al.*, 1949, Brown and Hoogland, 1986).

In Barheaded geese there was variation in response to humans, from little response at Thailur Lake to extremely alert and vigilant response in Nelligudda and T.G. Halli tanks. Such variations in vigilance and response have been observed for other bird species (Maclean *et al.*, 1991). The response also varied with season (Shedd, 1982), environmental factors (Lombardi and Curio, 1985a), Social context (Lombardi and Curio 1985b), behaviour of enemy (Buitron, 1983) and previous experience (Knight *et al.*, 1987).

Future Studies

A study of the needs of the Barheaded Goose will serve as guide to its preference of plant species, especially the crops. Change in crop pattern in future will also influence their distribution.

For example the population of Brent Goose in Europe fluctuate according to the supply of its favorite food, the Eel grass (*Zootera marina*) In 1935 a disease wiped out almost all the entire Eel grass and the European population of

Food choice depends on the species, individual preferences, seasonal availability and inter-specific competition (Mundkur and Allport, 1992). Collection of information on the food of waterfowl has been the focal point of the study for many years and has to be approached from various angles. Analysis of droppings of birds is gaining increasing importance as they are useful and non destructive methods that do not involve catching or killing of the bird. Analysis of the dropping can be used to quantify the dietary preferences (Bedard, 1986) of the Barheaded Goose in Karnataka.

In order to further understand what role a particular site holds in attracting the goose, it is necessary to study the daily activity pattern and biology of Barheaded Goose in their wintering grounds; whether they use the site for feeding, resting or both.

Presently, changes in the landscape and drainage pattern, including a major water abstraction scheme are underway in the Cauvery river delta; surrounding, Hadinaru, Kaggalipura, Chikkahalli and Yeriur tanks. These tanks are most important sites for the wintering Barheaded Goose population. The scheme when implemented could ultimately lead to undesirable conditions for the Barheaded Goose.

Goose use a variety of feeding methods (Amart *et al.*, 1991). The study of various aspects of feeding ecology will give crucial insight about their dietary needs which in turn can be used for forecasting the impact of the water abstraction schemes on the wintering population of Barheaded Goose and the likely changes in their migratory trends. It is therefore crucial to study the ecological requirements and the thresholds of tolerance of Barheaded Goose and other important waterfowl in the state and what effects the alteration of the habitat will ultimately lead to.

Studies in China have revealed that the Bar headed goose is threatened by habitat loss (due to dry weather), predators (destroying eggs and nestlings) and over hunting. The current population of Barheaded Goose in China is estimated to be about 20,000 individuals, mainly in Qinghai-Tibet plateau. A complete survey of Hulun Hu in the inner Mongolia, formerly a main breeding site for the Barheaded geese was made by Tong Young- cahang, but none was found (Jianjian, 1991).

It is suggested that efforts should be made to search for other potential winter areas of the state, with similar habitats and the distribution pattern of geese in other states as well to draw a comprehensive conservation strategy.

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Table 1. List of Asian Geese and their status in India

	English name	Scientific name	Status in India
1.	Swan Goose	*Anser cygnoides*	
2.	Bean Goose	*Anser fabilis*	Rare migrant.
3.	White-fronted Goose	*Anser albifrons*	Rare migrant to north India, upto Orissa.
4.	Lesser-White-fronted Goose	*Anser erythropus*	Rare migrant to N. India upto Maharashtra.
5.	Greylag Goose	*Anser anser*	Regular migrant upto Orissa, rare in Deccan.
6.	Barheaded Goose	*Anser indicus*	Breeds in Ladakh, Central Asia from Tien Shan to Koknonur. Winters – North India, rare in Deccan, leap frogging upto Karnataka.
7.	Snow Goose	*Anser caerulescens*	
8.	Emperor Goose	*Anser canagicus*	
9.	Canada Goose	*Branta canadensis*	
10.	Brent Goose	*Anser bernica*	
11.	Red Breasted Goose	*Branta ruficollis*	

Adapted from (Ali and Ripley, 1987; Zheng, 1976).

Table 2. List of important wetlands for the wintering Barheaded Geese population in Karnataka, South India

No. of B.H. Geese	Wetlands	District	Co-ordinates
1001 to 2000	Hadinaru	Mysore	N 1210 E 7645
	Kaggalipura*	Mysore	N 1216 E 7653
501 to 1000	Hoskote	Bangalore	N 1308 E 7777
	Yeriyur Kere	Mysore	N 1204 E 7702
	Chikkaballi	Mysore	N 1240 E 7654
301 to 500	Akkialur	Dharwad	N 1445 E 7510
	Naregul	Dharwad	N 1447 E 7505
101 to 300	T.G. Halli	Bangalore	N 1277 E 7735
	Tailur	Mandya	N 1297 E 7708
	Karanji Kere	Mysore	N 1217 E 7640
	Budigere Ammanni	Bangalore	N 1315 E 7775
	Melina Thota	Bangalore	N 1327 E 7772
	Kunigal Dodda Kere	Tumkur	N 1302 E 7702
	Byramangala	Bangalore	N 1277 E 7743
	Merchad Tank	Raichur	N 1615 E 7720
	Mare Halli Kere	Mysore	N 1221 E 7703
	Yedeur Gaddahalla	Mysore	N 1155 E 7655
	Halavarada Kere	Mysore	N 1211 E 7654
	Dasara Halli	Bangalore	N 1319 E 7743
	Khanapur Tank	Gulbarga	N 1645 E 7702

Note:

1) * Reported more than 500 Barheaded Geese in all the years since 1988.

2) Number of Geese counted on a single visit to the wetland by the survey team.

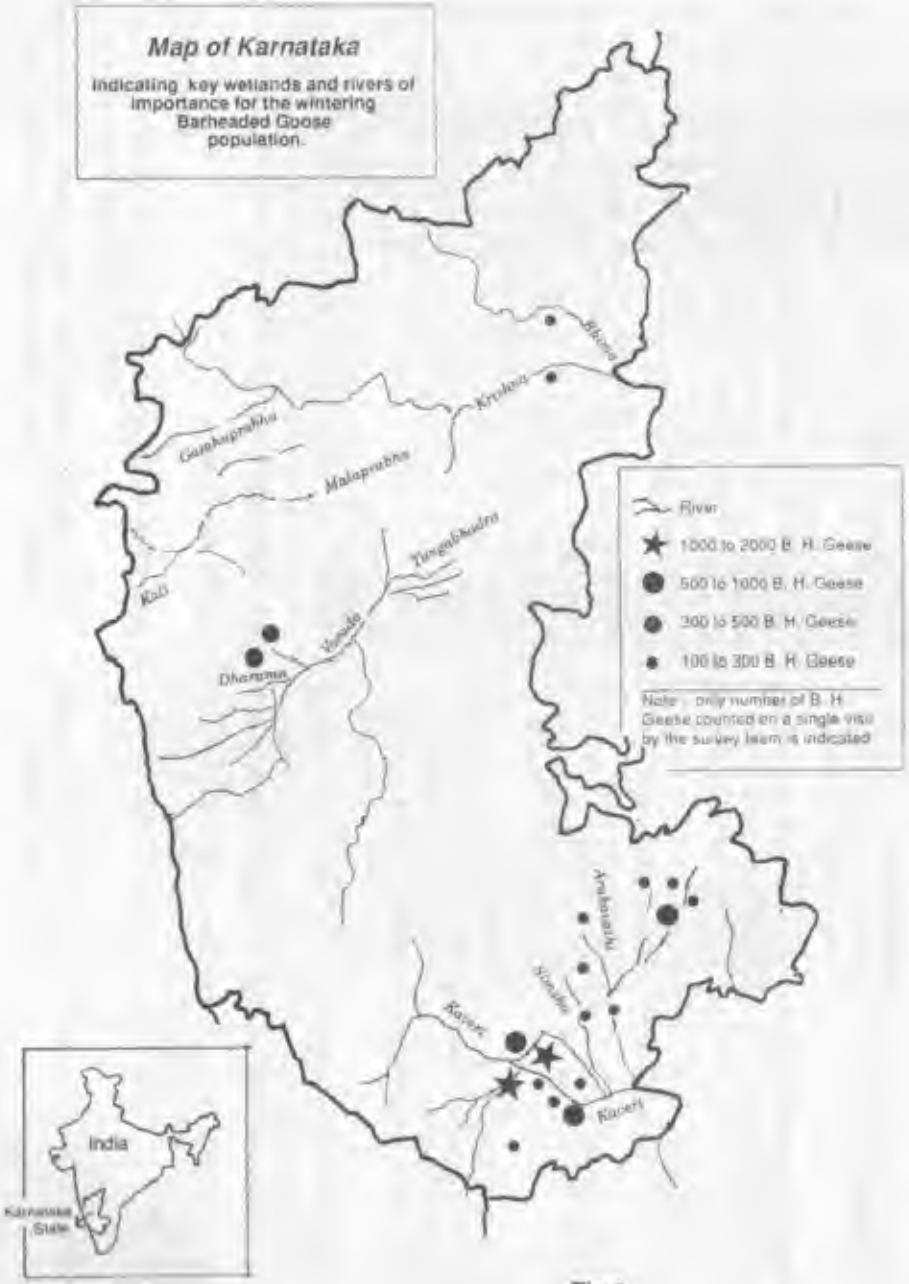
Map of Karnataka
Indicating key wetlands and rivers of importance for the wintering Barheaded Goose population.
River
1000 to 2000 B. H. Geese
500 to 1000 B. H. Geese
300 to 500 B. H. Geese
100 to 300 B. H. Geese
Note : only number of B. H. Geese counted on a single visit by the survey team is indicated
Bhima
Krishna
Ghataprabha
Malaprabha
Tungabhadra
Kali
Sharavathi
Dharwad
Arkavathi
Hemavathi
Kaveri
Kabini
India
Karnataka State

Fig.1.


Barheaded Geese - wintering population
Survey Results 1988-92 Karnataka/India
(Wetlands x 100),(Geese x 1000)
20
15
10
5
0
1988
1989
1990
1991
1992
Years Surveyed
Wetlands/Karnataka
Wetlands/India
B H Geese/Karnataka
B H Geese/India
SRIDHAR

Fig.2

The Avifauna of the Andaman and Nicobar Islands : A Review and the Current Scenario

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Introduction

Over 10% of all bird species are threatened with extinction today, the majority of these are found in tropical forests and islands (Mountford 1988). About 93% of all avian taxa are island endemics (King 1981). Island ecosystems, in their natural state, tend to be finely tuned as the limits on the resources base are acute (Carew-Reid 1990). This ecological refinement makes them, particularly vulnerable to changes resulting from human activities. Increased human populations, and increasing demands of resources in islands have resulted in fragile island ecosystems being severely threatened today.

India has two main groups of islands, the Andaman & Nicobar Islands off the eastern coast and Lakshwadeep Islands off the western coast. The increase over recent decades in human activity in these islands has resulted in grave concern of the endemic taxa.

Geographically isolated island groups are of particular importance in the conservation planning of a country because of the large number of endemic species found within them. The Andaman & Nicobar group of islands is no exception. Of the 270 species and subspecies of birds recorded from the island group, 105 are endemics. This high proportion of endemism (38.2%) makes the Andaman and Nicobar Islands a priority area for avifauna conservation.

Material and Methods

One of the problems for planning a protected area in the Andaman and Nicobar islands is the lack of sufficient information on avifauna of different Islands. Though there has been a considerable taxonomic work in the Andaman & Nicobar islands, the segregation of species according to the islands is incomplete. This study is a beginning in this direction. It essentially makes checklists of the species of each island or group of islands.

The origins of the avifauna of the Andaman islands were thought to be from Burma while those of the Nicobar islands, from Sumatra (Mani 1974), and the avifauna of the two island groups were thought to differ substantially. However, Ripley & Beehler (1989) found that the breeding avifauna of the Nicobars was essentially an impoverished sub-set of the Andamans, and that the avifauna of the Bay islands are more closely allied with the source avifauna of south-western Burma and the Malay Penninsula, with Burma being substantially more important. In this study, the Andaman and Nicobar Islands are considered as two distinct groups.

Andaman & Nicobar islands

The Andaman groups of islands in the Bay of Bengal are peaks of a submerged mountain range, arching from Arakan Yoma in Burma in the north to Sumatra in Indonesia in the south, between Latitudes 6 45' and 13 41' N and Longitudes 92 12' and 93 57'E (Saldanha, 1989, Daljar *et al.*1991), and are a southern extension of the Arakan Yoma mountain range. The island group comprises of over 300 islands and over 260 rocks (Singh, 1981), with a total coastline of 1962 km. The entire island group covers 8,249 sq.km. (Singh, 1981, Saldanha, 1989).

The study consists of two parts, a literature review of the avifauna of the Andaman & Nicobar islands and a checklist of the birds of eight islands of the Nicobars and 4 main island groups in the Andamans (see Table 1). The checklist is based on all confirmed sightings. In addition, an approximate count of all the times a species was sighted or heard was kept, thus giving a relative frequency occurrence for individuals. As we are mainly interested in the endemics, information on the same is presented here.

Results and Discussion

The total number of species and subspecies recorded from the Andaman & Nicobar Islands is 270, of these 126 species are exclusive to the Andaman group and 56, to the Nicobar group (Table 2, for list see Table 5). Five species recorded during this survey were additions to the Nicobars and three species were added to the Andaman list.

Endemism

The Andaman & Nicobar Islands have a high proportion of endemics (38.2% of species recorded from the islands are endemic), largely due to the high number of endemic subspecies. Of the 105 species and subspecies endemic, 14 are species with 17 subspecies. Of the endemics, 82 (or 78.1%) are subspecies of species found on neighbouring mainlands. (Table 3). Of the 14 species endemic to the Andaman & Nicobar islands, 5 are exclusive to the Nicobar islands, 6 to the Andaman islands and 3 to both.

The Andaman group has a greater number of endemic species exclusive to that group than that of the Nicobar islands (Table 3). However, if area is taken into consideration, the ratio of exclusive endemic species or subspecies per sq. km. is higher in the Nicobars than in the Andamans (Nicobars 0.021 spp per sq. km, Andamans=0.008 spp per sq.km). Similarly, the ratio of endemic per number of Islands than too Nicobar has a

greater degree of endemicity (Nicobars 1.63 spp. per island, Andamans 0.16 spp. per island)

Of the 66 endemic species present in the Andaman group, 52 were seen. Of the 56 endemic species recorded in the Nicobars, 34 were sighted. The species endemic not seen during this survey were the Nicobar Hawk-Owl and the Narcondam Hornbill (Narcondam island was not surveyed).

Though the avifauna of the Nicobars has been considered as an impoverished subset of that of the Andaman group (Ripley & Beehler, 1989), it is clear from the available information, that the Nicobars has a higher degree of endemism than the Andamans. One possible reason is that the inter-island distances are greater in the Nicobars than in the Andamans.

Within the Nicobar group, there are two species endemic exclusive to the Great Nicobar group (Blyth's Nicobar Parakeet and Great Nicobar Crested Serpent Eagle) while the Nicobar Bulbul is exclusive to the Nancowry group. The Nicobar Shikra and the Nicobar Scrubfowl are common to both groups. Similar patterns are seen with endemic sub-species as well. Thus, based on the avifauna profiles of the Nicobars, two islands subgroups are evident, these being the Nancowry and the Great Nicobar groups. The avifauna profile of the Andaman group is as yet unclear, but some patterns are emerging. For instance, the large Andaman Drongo occurs in the middle Andamans while the small Andaman Drongo occurs in the south and Little Andamans. The little, although isolated from the rest of the Andamans by the Duncan passage does not seem to have evolved specific avifauna.

Introduced species

Having been colonised by non-ethnic people for over a century, several species of avifauna have been introduced in the Andaman & Nicobar islands. The Andaman group has had a greater number of introductions than the Nicobar group (TAble 4). Two species introduced from the mainland, the Common Myna and the House Saprrow have become very common.

The Nicobars have fortunately not had many introductions from mainland India, with only the Blue Rock Pigeon having been introduced into Car Nicobar, and domestic strains (perhaps less than 100 birds) now being present on Great Nicobar as well. The Common Myna was probably only introduced on Car Nicobar, as it was not seen during this survey. The Nicobars have had introductions from the Andaman group. The two introductions, the Andaman Red Whiskered Bulbul, an endemic form has now become very common in the Nancowry group, and the Andaman Whiteheaded Myna, another endemic, was supposed to be common on Camorta but this species was not seen there.

Distribution of avifauna within the island group

Of critical importance to the conservation of avifauna is the documentation of distributions of species within an island group. Table 5 summarises the avifauna of the Andaman & Nicobar group of Islands from an exhaustive literature review. Tables 6 & 7 present the data collected for eight islands in the Nicobar group and 4 island sub-group from the Andamans, and gives an abundance ranking as well to give some idea of the frequency at which species were sighted.

Species under pressure

Only four species, the Andaman Teal *Anas gibberifrons albogularism* the Andaman Greyrumped Swiftlet *Collocalia fuciphaga inexpectata*, the North Nicobar Scrubfowl *Megapodius nicobarensis nicobariensis* and the Nicobar Bulbul *Hypsipetes nicobariensis* the latter a full species endemic and the former three subspecies endemics are threatened. While the Andaman Greyrumped Swiftlet occurs throughout the Andaman & Nicobar islands, the Nicobar Bulbul is endemic to Nancowry, Camorta, Katchall and Trinkat islands of the Nancowry group, and the Andaman teal is present only in the Andaman group.

Several examples of introduced species causing extinction or rarity of endemic species in islands ecosystems are present (e.g. Recher & Clark 1974, Atkinson 1989, Olson 1989, Carew-Reid 1990, Baker 1991). The introduction of the Andaman Red Whiskered Bulbul in the Nancowry group of islands has probably resulted int he rarity of the Nicobar Bulbul. The Andaman Red Whiskered Bulbul is currently widespread and very common in the Nicobar group of islands. The Nicobar Bulbul, which was said to be common in the Nancowry group is now very rare. This species was sighted less than 5 times in two separate locations in Comorta, once on Nancowry and 4 to 5 times in Katchall. In contrast, the Red Whiskered Bulbul was seen at least more than 75 times. It is probable that the Nicobar Bulbul is becoming rare because of competition with the Andaman Red Whiskered Bulbul. This, however, requires further study.

The Andaman Greyrumped Swiftlet was never as common in the Nicobars as it was in the Andamans (Ali & Ripley 1983). This species has become rare in the Andaman and Nicobars primarily due to over-exploitation of the nests. This species, belongs to the 'white nest swiftlet' group, whose nests are made entirely of agglutinated saliva, and are of a very high commercial value in the international market. In the Andaman & Nicobar Islands a kg of nests (one kg normally consists of about 70 nests) fetches between 5 and 8 thousand rupees, and can cost even as much as Rs.10 or 12,000 in Port Blair. From the information gathered, virtually all colonies are exploited, and nest collected goes on irrespective of whether there are eggs or chicks in them. There have been instances in the past when a heap of chicks and eggs a foot high have been left behind after nest collection.

The Andaman teal has become rare due to habitat loss and hunting. As surface fresh water is scarce in the islands, human pressures on available water is high, with the resultant reclamation or disturbances. As a species the Nicobar Scrubfowl, the only megapode species in India, is not threatened. However, of the two sub species present in

the Nicobar group of Islands, *M.n. nicobariensis* has become rare primarily due to the conversion of its habitat to coconut plantations.

The Nicobar Scrubfowl, *Megapodius nicobariensis* in India was considered endangered (Anonymous 1988). However, as a species it is safe, but the Northern sub-species *M.n. nicobariensis* is threatened today. The Narcondam Hornbill *Aceros narcondami* was also found to be common to Narcondam Island (V Prakash pers. comm.) but is a species whose numbers need to be monitored because it is endemic to an island of less than 7 sq km.

Conservation Perspectives

As yet, the endemic avifauna of the Andaman & Nicobar islands are not under immediate threat. However, if conservation is not implemented now, the future will be bleak. Most of the endemic avifauna of the Andaman and Nicobar are forest dwelling species and some endemics are restricted to very small islands. As the limits on the resource base are acute due to strict geographical limits (Carew-Reid 1990) any change of vegetation cover will prove detrimental to the endemics.

There are two primary conservation problems in the island group. The first is by the settlements of mainlanders who have cleared forest to farm. The second is through the development of infrastructure for the mainlanders who have settled in the islands and for the commercial exploitation of the island group. Until the loss of forest is controlled, perhaps even reversed, and as much of the islands are left as we found them, the future is grim not only for the endemic fauna and flora, but for the indigenous tribes to whom these islands, in reality, belong.

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Table 1: Time spent on various islands

Island	Area (sq km)	Dates	No of days
Nicobar group	-	-	-
Great Nicobar	1045.1	11-12-92 to 28-1-93 19-2-93 to 28-2-93	56
Littel Nicobar	159.1	28-1-93 to 15-2-93	18
Pilo Milo	1.3	16-2-93 to 18-2-93	2
Camorta	188.2	1-3-93 to 18-3-93	17
Trinkat	30	19-9-93 to 24-3-93	5
Nancowry	66.9	26-3-93 to 29-3-93	4
Katchall	174.6	31-3-93 to 3-4-93	4
South Andaman	Not available	13-5-93 to 5-5-92 5-5-92 to 11-5-92	9
North Andaman	1348	18-3-93 to 26-3-93	7
Middle Andaman	1070	26-3-93 to 28-3-93	2
Little Andaman	3	29-3-93 to 1-4-93	3

Table 2: Number of species recorded from the Andaman and Nicobar Islands

Island group	Total spp	Exclusive spp
Andaman	214	126
Nicobars	144	56

Table 3 : Endemism in the Andaman and Nicobar Islands

Total spp endemic to A & N Is	105
Spp endemic to Andaman group	49
Spp endemic to Nicobar group	39
Endemic spp common to both groups	17
Endemic full spp (with 17 sub-species)	14
Endemic sub species (incl. those of endemic full spp.)	98

Table 4: Species introduced in the Andaman and Nicobar Islands

Species	Island/s	Year	Status
Grey Patridge	Andamans	C 1890	Uncommon
Indian Peafowl	Andamans	?	Uncommon
Blue Rock Pigeon	Andamans	?	?
	Car Nicobar	1898	?
Little Brown Dove	Andamans	1899	?
Roseringed Parakeet	Andamans	1863	Died out
Andaman Whiteheaded Myna	Comorta	?	Common
Indian Myna	A & N Is	1867	V Common
Andaman Red Whiskered Bulbul	Camorta	?	V Common
	Trinkat		
House Sparrow	Andamans	1882	V Common
		1895	
Tree Sparrow	Andamans	< 1866	Died out
Red Munia	Andamans	< 1873	Died out
Blackheaded Munia	Andamans	< 1906	Died out

TABLE 5. THE BIRDS OF THE ANDAMAN & NICOBAR ISLANDS - A LITERATURE REVIEW

Common name	Species	E	NE	A	N	S	Distribution
Wilson's storm petrel	*Oceanites oceanicus oceanicus*		+	+		?	
Dusky-vented storm Petrel	*Fregetta tropica melanogaster*		+			?	
Short-tailed tropic-bird	*Phaethon aethereus indicus*		+	+		?	
Red-tailed tropic-bird	*Phaethon rubricauda rubricauda*		+		+	?	
Long-tailed tropic-bird	*Phaethon lepturus lepturus*		+	+		?	
Grey or Spottedbilled Pelican	*Pelecanus philippensis philippensis*		+		+	V	
Redfooted booby	*Sula sula rubripes*		+	+		?	
Purple heron	*Ardea purpurea manilensis*		+	+	+	U	
Dusky grey heron	*Ardea sumatrana sumatrana*		+		+	?	
Little green heron	*Butorides striatus spodiogaster*		+	+	+	C	
Indian Pond heron	*Ardeola grayii*		+	+	+	?	
Chinese pond heron	*Ardeola bacchus*		+	+		?	
Cattle egret	*Bubulcus ibis coromandus*		+	+	+	C	
Large egret	*Egretta alba modesta*		+	+		?	
Intermediate egret	*Egretta intermedia intermedia*		+	+	+	?	
Little egret	*Egretta garzetta garzetta*		+	+	+	C	
Eastern reef heron	*Egretta sacra*		+	+	+	C	
Night Heron	*Nycticorax nycticorax nycticorax*		+		+	?	
Nicobar Tiger bittern	*Goraschius melanolophus minor*	?			+	R	
Chestnut bittern	*Ixobrychus cinnamomeus*		+	+	+	C	
Yellow bittern	*Ixobrychus sinensis*		+	+	+	?	
Lesser whistling teal	*Dendrocygna javanica*		+	+	+	C	
Brahminy duck	*Tadorna ferruginea*		+	+		V	
Common teal	*Anas crecca crecca*		+	+	+	?	
Andaman teal	*Anas gibberifrons albogularis*	+		+		?	
Spotbill duck	*Anas poecilorynchа*		+	+		V	
Cotton teal	*Nettapus coromandelianus coromandelianus*			+		V	
Andaman blackcrested baza	*Aviceda leuphotes andamanica*	+		+		?	S Andaman Is
Pariah kite	*Milvus migrans govinda*		+	+		V	
Shikra	*Accipiter butleri butleri*	+			+		Car Nicobar I
Shikra	*Accipiter butleri obsoletus*	+			+		S. Nicobar Is
Horsfield's Goshawk	*Accipiter soloensis*		+	+	+	?	
Sparrow hawk	*Accipiter nisus nisosimilis*		+	+		M	
Eastern (Besra) sparrow hawk	*Accipiter virgatus gularis*	?		+		?	
Andaman crested hawk-eagle	*Spizaetus cirrhatus andamanensis*	+		+			
Whitebellied sea eagle	*Haliaeetus leucogaster*		+	+	+	C	
Grey-headed fishing eagle	*Ichthyophaga ichthyaetus ichthyaetus*		+	?		?	
Pale harrier	*Circus macrourus*		+	+	?	?	
Montagu's harrier	*Circus pygargus*		+	+	+	?	
Marsh harrier	*Circus aeruginosus aeruginosus*		+	+	?	?	

Burmese crested serpent eagle	*Spilornis cheela burmanicus*		+	+		?	
Andaman pale serpent eagle	*Spilornis cheela davisoni*	+		+	+	?	
Nicobar crested serpent eagle	*Spilornis cheela minimus*	+			+	?	Endemic to Camorta-Nancowry-Teressa-Katchall group
Great Nicobar crested	*Spilornis klossi*	+			+	?	Endemic to Great Nicobar
Andaman dark serpent eagle	*Spilornis elgini*	+		+		?	Endemic to South Andaman Is.
Osprey	*Pandion haliaetus haliaetus*		+	+	+	?	
Peregrine falcon	*Falco peregrinus japonensis*		+	+		?	
Peregrine falcon	*Falco peregrinus peregrinator*		+		+		
Kestrel	*Falco tinnunculus* subssp		+	?			
North Nicobar megapode	*Megapodius n. nicobariensis*	+			+	?	Nicobar Is N of Soebrero channel
South Nicobar megapode	*Megapodius n. abbotti*	+			+	C	Endemic to Great & Little Nicobar
Grey partridge	*Francolinus p. pondicerianus*		+	+		U	Introduced from mainland India c. 1890
Nicobar bluebreasted quail	*Coturnix chinensis trinkutensis*	+			+	C	Car Nicobar, Trinkut, Camorta
Common peafowl	*Pavo cristatus*		+	+		U	Introduced
Indian yellow-legged button quail	*Turnix tanki tanki*		+	+	+	C	
Button quail	*Turnix tanki albiventris*	?		+	+	?	Only N.A.
Andaman bluebreated banded rail	*Rallus striatus obscurior*	+		+	+?	C	
Nicobar bluebreated banded rail	*Rallus striatus nicobarensis*	+			+	C	
Andaman banded crake	*Rallina canningi*	+		+		C	
Baillon's crake	*Porzana pusilla pusilla*		+	+		MC	
Andaman whitebreasted waterhen	*Amaurornis phoenicurus insularis*	+		+	+	C	
Whiteheaded waterhen	*Amaurornis phoenicurus leucocephalus*				+	C	
	Amaurornis p. nicobaricus	+			+		
Water cock or Kora	*Gallicrex cinerea cinerea*		+	+	+	?	
Purple moorhen	*Porphyrio porphyrio poliocephalus*		+	+	+	?	
Malay Moorhen	*Gallinula chloropus orientalis*		+	+		V?	Single specimen from near Port Blair
Greyheaded lapwing	*Vanellus cinereus*		+	+		V	
Grey plover	*Pluvialis squatorola*		+	+	+	?	
Golden plover	*Pluvialis dominica fulva*		+	+	+	?	
Large sand plover	*Charadrius leschenaultii*		+	+	+	?	
Eastern sand plover	*Charadrius asciaticus veredus*		+	+		V	
Kentish plover	*Charadrius alexandrinus*		+		+	?	
Little ringed plover	*Charadrius dubius curonicus*		+	+		C	
Lesser sand plover	*Charadrius mongolus atrifrons*		+	+	+	C	
Whimbrel	*Numenius phaeopus phaeopus*		+	+	+	C	
Curlew	*Numenius arquata orientalis*		+	+	+	?	
Bartailed godwit	*Limosa laponica laponica*		+		+	M	
Redshank	*Tringa totanus totanus*		+	+	+	MC	
Greenshank	*Tringa nebularia*		+	+	+	MC	
Green sandpiper	*Tringa ochropus*		+	+	?	M	
Wood sandpiper	*Tringa glareola*		+	+	?	M	
Terek sandpiper	*Tringa terek (Xenus cinereus)*		+	+		M	
Common sandpiper	*Tringa (Actitis) hypoleucos*		+	+	+	M	

Turnstone	*Arenaria interpres interpres*	+	+	+	M	
Pintail snipe	*Capella (Gallinago) stenura*	+	+	+	MC	
Swinhoe's snipe	*Capella (Gallinago) megala*	+	+		MU	
Fantail snipe	*Capella (Gallinago) g. gallinago*	+	+		M	
Jack snipe	*Capella (Lymnocryptes) minima*	+	+		MU	
Woodcock	*Scolopax rusticola rusticola*	+	+		?	Single ? record from Port Blair
Eastern knot	*Calidris tenuirostris*	+	+		MU	
Eastern little stint	*Calidris ruficollis*	+	+	+	M	
Little stint	*Calidris minutus*	+	+	+	M	
Longtoed stint	*Calidris subminutus*	+	+		M	
Curlew-sandpiper	*Calidris testaceus (ferruginea)*	+	+		M	
Sanderling	*Calidris albus*	+		+	M	
Broadbilled sandpiper	*Limicolla falcinellus* subsp.	+	+	+	M	
Crab plover	*Dromas ardeola*	+	+	+	M	
Great stone plover	*Esacus magnirostris magnirostris*	+	+	?	R	
Large Indian pratincole	*Glareola pratincola maldivarum*	+	+	?	MO	
White-winged black tern	*Chlidonias leucoptera*	+	+		V?	
Javan gullbilled tern	*Gelochelidon nilotica affinis*	+	+		V?	
Roseate tern	*Sterna dougallii korustes*	+	+	?	R	
Eastern blacknaped tern	*Sterna sumatrana sumatrana*	+	+	+	R	
Brownwinged tern	*Sterna anaethetus* subspp	+	+		V?	
Sooty tern	*Sterna fuscata nubilosa*	+	?		?	
Large crested tern	*Sterna bergi* subsp.	+		+	?	
Indian lesser crested tern	*Sterna bengalensis bengalensis*	+	+	+	?	
Noddy tern	*Anous stolidus pileatus*	+	+	+	R?	
Whitecapped noddy tern	*Anous tenuirostris worcesteri*	+	+		S	
Andaman pompadour pigeon	*Treron pompadora chloroptera*	+		+	+	R	Common in S & M Andamans
Andaman Pompadour pigeon	*Treron pompadora andamanica*	+		+		R	
Nicobar green imperial pigeon	*Ducula aenea nicobarica*	+			+	RC	Most Nicobar Is
Andaman green imperial pigeon	*Ducula aenea andamanica*	+		+		RC	Throughout the group
Pied Imperial pigeon	*Ducula bicolor*		+	+	+	R	
Blue rock pigeon	*Columba livia intermedia*		+		+	?	Introduced in 1858 into Car Nicobar
Andaman wood pigeon	*Columba palumboides palumboides*	+		+		?	
Nicobar woodpigeon	*Columba palumboides nicobarica*	+			+	?	G Nicobar, Camorta, Nancowry
Andaman cuckoo-dove	*Macropygia rufipennis andamanica*	+		+	+	RC	Andaman & north Nicobar Is
North Nicobar cuckoo-dove	*Macropygia rufipennis rufipennis*	+			+	?	N Nicobar Is
Nicobar cuckoo-dove	*Macropygia rufipennis tiwarii*	+			+	RC	Great Nicobar
Burmese red turtle dove	*Streptopelia tranquebarica humilis*		+	+		R	
Burmese spotted dove	*Streptopelia chinensis tigrina*		+		+	V?	Single record from Nicobar
Indian little brown dove	*Streptopelia senegalensis cambayensis*	+	+			?	Possibly introduced c. 1895
Andaman Emerald dove	*Chalcophaps indica maxima*	+		+		R	Andaman Is only
Nicobar Emerald dove	*Chalcophaps indica augusta*	+			+	R	Nicobar Is only
Nicobar pigeon	*Caloenas nicobarica nicobarica*		?	+	+	R	Nancowry, Camorta, Car Nicobar
Large Andaman parakeet	*Psittacula eupatria magnirostris*	+		+		R	Not recorded south of 10° channel

Rose ringed parakeet	*Psittacula krameri*		+	?			Introduced in c. 1863. Died out by 1873
Andaman rebreasted parakeet	*Psittacula alexandri abbotti*	+		+		RC	
Blyth's Nicobar parakeet	*Psittacula caniceps*	+			+	R	Only from G. Nicobar, Montschal & Kondul
Andaman redcheeked parakeet	*Psittacula longicauda tytleri*	+		+		RC	Very common on all Andaman Is
Nicobar redcheeked parakeet	*Psittacula longicauda nicobarica*	+			+	RC	Very common on all Nicobar Is
Indian lorikeet	*Loriculus vernalis vernalis*		+	+	?	RV	
Indian cuckoo	*Cuculus micropterus micropterus*		+	+	+	?	
Cuckoo	*Cuculus canorous* subsp.		+	+		V	1 record from Andamans
Himalayan cukoo	*Cuculus saturatus saturatus*		+	+	+	C	
Small cuckoo	*Cuculus poliocephalus poliocephalus*		+	+		R?	
Indian drongo cuckoo	*Surniculus lugubris*		+		+	?	1 Shot in Katchal, sighted Campell bay
Emerald cuckoo	*Chalcites maculatus*		+	+	+	?	
Violet cuckoo	*Chalcites xanthorhynchus xanthorhynchus*		+	+		?	1 specimen from near Port Blair
Andaman Koel	*Eudynamus scolopacea dolosa*	+		+	+	?	
Andaman crow pheasant	*Centropos (sinensis) andamensis*	+		+	?	R	Andamans, Great & Little Coco, Table Is
Andaman barn owl	*Tyto alba deroepstroffi*	+		+		R?	Few specimens from S Andaman
Andaman scops owl	*Otus balli*	+		+		R	
Andaman scops owl	*Otus scops modestus*	+		+		R?	
Nicobar scops owl	*Otus scops nicobaricus*	+			+	?	Campbell bay.
Brown hawk-owl	*Ninox scutulata obscura*	+		+	+	RC	
Andaman hawk-owl	*Ninox affinis affinis*	+		+		RC	
Nicobar hawk-owl	*Ninox affinis isolata*	+			+	RC	Car Nicobar, Trinkat & Camorta.
	Ninox affinis rexpimenta	+			+	?	Gt Nicobar Is.
Spotted wood owl	*Strix selaputo*		+	?	?		
Fish owl	*Ketupa javanensis*		+	?	?		
Migratory nightjar	*Caprimulgus indicus jotaka*		+	+		?	
Andaman longtailed nightjar	*Caprimulgus macrurus andamanicus*	+		+		RC	
Himalayan swiftlet	*Collocalia brevirostris brevirostris*		+	?		?	
Hume's swiftlet	*Collocalia b. innominata*		+	+		?	
Andaman grevrumped swiftlet	*Collocalia fuciphaga inexpectata*	+		+	+	RC	Less in Nicobars.
Whitebellied swiftlet*	*Collocalia esculenta affinis*	+		+	+	RC	
Brownthroated spinetail swift	*Chaetura gigantea indica*		+	+	?	RC	
Eastern swift	*Apus apus pekinensis*		+	+		V?	Single specimen on July 30th 1873
Indian small blue kingfisher	*Alcedo atthis bengalensis*		+	+	+	R?	
Andaman blue-eared kingfisher	*Alcedo meninting rufigastra*	+		+		RC	South & Middle Andaman Is
Andaman three-toed kingfisher	*Cevx erithacus macrocarus*	+		+	+	R	Common in the Nicobars; 3 records from the Andamans
Three-toed kingfisher	*Cevx erithacus erithacus*		+	+	+	M	
Andaman storkbilled kingfisher	*Pelargopsis capensis osmastoni*	+		+		RC	
Nicobar storkbilled kingfisher	*Pelargopsis c. intermedia*	+			+	R	Galatea bay, Kondul, Pilu Milu, Montshall & L Nicobar
	Pelargopsis capensis shekari	+		+		?	S Andaman
Andaman ruddy kingfisher	*Halcyon coromanda mizorhina*	+		+		R	Not uncommon S Andaman; Barren & S Jolly Boy Is.

Andaman whitebreasted kingfisher	*Halcyon smyrnensis saturatior*	+		+		RC	V common in M & S Andaman
Blackcapped kingfisher	*Halcyon pileata*		+	+	+	RC	
Andaman whitecollared kingfisher	*Halcyon chloris davisoni*	+		+		RC	Andaman & Coco Is
Nicobar whitecollared kingfisher	*Halcyon chloris occipitalis*	+		.	+	RC	Nancowry, CarNic, Trinkut, Camorta.
Andaman chestnutheaded bee-eater	*Merops leschenaulti andamanensis*	+		+		RC	Coco, Andamans
Bluetailed bee-eater	*Merops philippinus philippinus*		+	+	+	MC	
Andaman broadbilled roller	*Eurystomus orientalis gigas*	+		+		RC	S & M Andamans
Narcondam hornbill	*Rhyticeros (Aceros) narcondami*	+		+		RC	Endemic to Narcondam Is
Andaman black woodpecker	*Dryocopus javensis hodgei*	+		+		RC	
Andaman spottedbreasted pied w.p.	*Picoides macei andamanensis*	+		+		RC	
Nicobar greenbreasted pitta	*Pitta sordida abbottii*	+			+	R?	G & L Nicoabr
Swallow	*Hirundo rustica gutturalis*		+	+	+	MC	
Javan house swallow	*Hirundo tahitica javanica*		+	+		R?	
Japanese redrumped swallow	*Hirundo daurica japonica*		+	?		V	Single doubtful record from Port Blair
Brown shrike	*Lanius cristatus cristatus*		+	+	?	M?	
Philippine shrike	*Lanius cristatus lucionensis*		+	+	?	MC	
Andaman blacknaped oriole	*Oriolus chinensis andamanensis*	+		+		RC	S & M Andamans
Nicobar blacknaped oriole	*Oriolus chinensis maccourus*	+			+	RC	CarNic, C Nicobars, Nancowry, Camorta, Trinkat, G Nicobar
Blackheaded oriole	*Oriolus xanthornus (andamanensis)*	?		+		?	
Grey or ashy drongo	*Dicrurus leucophaeus*		+	?	?	?	Single specimen 5th Nov. 1874
Whitecheeked grey drongo	*Dicrurus leucophaeus leucogenys*		+	+		?	
Crowbilled drongo	*Dicrurus annectans*		+		?	?	Single record.
Large Andaman drongo	*Dicrurus andamanensis dicruriiformis*	+		+		R	Great Coco & Table Is
Small Andaman drongo	*Dicrurus andamanensis andamanensis*	+		+		R	Little & S Andaman Is
Andaman racket tailed drongo	*Dicrurus paradiseus otiosus*	+		+		RC	N, M, S & Little Andaman Is
Nicobar racket tailed drongo	*Dicrurus paradiseus nicobariensis*	+			+	RC	CarNic, Katchall, L & G Nicobars
Whitebreasted swallow shrike	*Artamus leucorhynchus humei*	+		+		RC	Coco, Andaman Is
Andaman glossy stare	*Aplonis panayensis tytleri*	+		+	+	RC	
Glossy tree stare	*Aplonis panayensis albiris*	+			+	RC	Camorta, Trinkut, Nancowry & G Nicobar
Andaman whiteheaded myna	*Sturnus erythropygius andamanensis*	+		+		RC	Introduced on Camorta
Nicobar whiteheaded myna	*Sturnus erythropygius erythropygius*	+			+	RC	Only known from Car Nicobar
Katchall whiteheaded myna	*Sturnus erythropygius katchalensis*	+			+	RC	Katchall Is only; possibly hybrid between *S.e.a.* & *S.e.e.*
Daurian myna	*Sturnus sturninus*		+		+	O?	Three records, Camorta, between CarNic & L Andaman.
Rosy pastor	*Sturnus roseus*		+	+		V	2-3 records during severe winters.
Indian myna	*Acridotheres fristis fristis*		+	+	+	RC	Introduced c. 1867. Have spread through many Islands
Andaman hill myna	*Gracula religiosa andamanensis*	+		+	+	RC	
Nicobar hill myna	*Gracula religiosa halibrecta*	+			+	?	G & Central Nicobars
Andaman tree pie	*Dendrocitta bayleyi*	+		+		RC	
Eastern jungle crow	*Corvus macrorhynchus levaillantii*		+	+		RC	
Andaman large cuckoo shrike	*Coracina novaehollandiae andamana*	+		+		RC	

Barred cuckoo shrike	*Coracina striata dobsoni*	+		+		R	
Nicobar pied cuckoo-shrike	*Coracina (Lalage) melanoleuca nigra*	+			+	R	Trinkat, Camorta
Andaman scarlet minivet	*Pericrocotus flammeus andamanensis*	+		+		RC	
Eastern small minivet	*Pericrocotus cinnamomeus vividus*	+		+		R	
Fairy blue-bird	*Irena puella andamanica*		+	+	+	RC	
Andaman blackheaded bulbul	*Pycnonotus atriceps fuscoflavescens*	+		+		RR	S & M Andaman
Andaman red-whiskered bulbul	*Pycnonotus jocosus whistleri*	+		+	+	RC	S & M Andaman, introduced into Trinkat & Camorta
Nicobar bulbul	*Hypsipites nicobariensis*	+			+	RC	Nicobar Is except Car Nicobar
Olive flycatcher	*Rhinomyias brunneata nicobarica*		+	?	+	MC	G & L Nicobar. Migrant to S China ?
Brown flycatcher	*Muscicapa latirostris*		+	+		M	
Eastern redbreasted flycatcher	*Muscicapa parva albicilla*		+	+		M	Narcondam
Paradise flycatcher	*Terpsiphone paradisi nicobarica*	+		+	+	RM	Common in Nicobars, rare in S Andaman
Andaman blacknaped monarch	*Monarcha azurea tytleri*	+		+		RC	All Andaman Is, G & L Coco
Car Nicobar blacknaped monarch	*Monarcha a. idiochroa*	+			+	RC	Restricted to Car Nicobar
Nicobar blacknaped monarch	*Monarcha a. nicobarica*	+			+	RC	Nicobar Is except Car Nicobar
Mangrove whistler	*Pachycephala grisola*		+	+		R	
Andaman palefooted bush warbler	*Cettia pallidipes osmastoni*	+		+		RC	
Malay streaked fantail warbler	*Cisticola juncidis malaya*		+		+	RC	
Pallas's grasshopper warbler	*Locustella certhiola centralasiae*		+	+	+	M?	1 record each from Andaman & Nicobar
Streaked grasshopper warbler	*Locustella lanceolata*		+	+	+	M?	
Thickbilled warbler	*Phragamaticola (Acrocephalus) a. aedon*	+		+	+	MC	
Assam reed warbler	*Acrocephalus stentoreus amyae*		+	+		M?	
Eastern great reed warbler	*Acrocephalus orientalis*		+	+		M?	
Manipur dusky leaf warbler	*Phylloscopus fuscatus mariae*		+	+		M?	
Siberian dusky leaf warbler	*Phylloscopus fuscatus mariae*		+	+		M?	
Siberian yellowbrowed l.w.	*Phylloscopus inornatus inornatus*		+	+		M	Narcondam
Largebilled leaf warbler	*Phylloscopus magnirostris*		+	+		?	Single record from Mt Harriet
Eastern greenish leaf warbler	*Phylloscopus trochiloides trochiloides*	+		+		M	
Palelegged leaf warbler	*Phylloscopus tenellipes*		+		+	?	Single record 16 km off G Nicobar
Bluethroat	*Erithacus (Luscinia) s. svecicus?*		+	+		M?	N Europe, N Asia >> India, China
Andaman magpie-robin	*Copsychus saularis andamanensis*	+		+		R	Uncommon. S & M Andaman Is
Andaman shama	*Copsychus malabaricus albiventris*	+		+		RC	Andaman Is
Indian collared bush chat	*Saxicola torquata indica*		+	+		?R	
Indian blue rock thrush	*Monticola solitarius pandoo*		+	+	+	V?	3 records, Andaman & CarNicobar.
Whitebrowed ground thrush	*Zoothera sibirica sibirica*		+	+		V	One record from Port Blair.
Siberian thrush	*Zoothera sibrica davisoni*		+	+		?	
Andaman ground thrush	*Zoothera citrina andamanensis*	+		+		RC	
Nicobar ground thrush	*Zoothera citrina albogularis*	+			+	RC	Trinkut, Nancowry, Camorta & Katchal
Dark thrush	*Turdus obscurus*		+	+		SR	
Richards (paddyfield) pipit	*Anthus novaeseelandiae richardi*		+	+		MC	
Blyth's pipit	*Anthus godlewski*		+	+		V?	Single record.
Redthroated pipit	*Anthus cervinus*		+	+	+	M?	
Forest wagtail	*Motacilla (Dendronanthus) indica*		+	+		M?	

Greyheaded yellow wagtail	*Motacilla flava thunbergi*		+	+	M?	
Blueheaded yellow wagtail	*Motacilla flava beema*		+	+	M?	
Grey wagtail	*Motacilla c. caspica (c. cinerea)*		+	+	MC	
White wagtail	*Motacilla alba leucopsis*		+	+	M?	
Andaman flowerpecker	*Dicaeum concolor virescens*	+		+	RC	S & M Andamans
Andaman olivebacked sunbird	*Nectarinia jugularis andamanica*	+		+	RC	Andamans
Nicobar olivebacked sunbird	*Nectarinia jugularis klossi*	+			+ RC	Nicobar Is except Car Nicobar
Car Nicobar olivebacked sunbird	*Nectarinia jugularis procelia*	+			+ RC	Car Nicobar
Nicobar yellowbacked sunbird	*Aethopyga siparaja nicobarica*	+			+ RC	G, L Nicobar, Kondul & Moreo Is
Little spiderhunter	*Arachnothera longirostris*		+	?	?	Single sight record.
Nicobar white-eye	*Zosterops palpebrosa nicobarica*	+		+	+ RC	Andaman & N Nicobar Is; Not recorded from G & L Nicobar
House sparrow	*Passer domesticus*		+	+	RC	c. 12 introduced on Ross Is in 1982 and 20 in 1885.
Tree sparrow	*Passer montanus*		+	+	?	Introduced c 1866. Apparently died out.
Avadavat or red munia	*Estrilda amandava*		+	+	?	Introduced c 1873. Apparently died out.
Andaman whitebacked munia	*Lonchura striata fumigata*	+		+	RC	S & M Andamans
Nicobar whitebacked munia	*Lonchura striata semistriata*	+			+ RC	Central Nicobar Is and Car Nicobar
Blackheaded munia	*Lonchura malacca*		+	+	?	Introduced c 1906. Apparently died out
Yellowbreasted bunting	*Emberiza aureola aureola*		+		+ ?	1 record from Nicobar
Little bunting	*Emberiza pusilla*		+	+	?	1 rec. Mt. Harriet, S Andaman.

References

Abdulali 1964 a, 1964 b, 1966, 1967, 1971, 1974, 1978; Ali & Ripley 1983, Ripley 1982, Das 1971, Dasgupta 1978, Howard & Moore 1

TABLE 5: Distribution of birds of the Nicobar group of islands

Common name	B	GN	LN	PN	CA	TR	NA	KA
Purple heron		+	+					
Little green heron		+	+	+	+	+	+	
Indian Pond heron		+	+	+				
Cattle egret		+	?					
Intermediate egret		+			+			+
Eastern reef heron		+	+	+	+	+	+	+
Chestnut bittern		+						
Yellow bittern		+			+			
Shikra	+	+2	+2	+	+2			+1
Whitebellied sea eagle		+	+		+	+	+	+
Great Nicobar crested serpent eagle	+	+5	+3					
North Nicobar megapode	+				+2	+	+2	+2
South Nicobar megapode	+	+7	+5					
Nicobar bluebreasted quail	+				+2	+2	+2	
Whitebreasted waterhen	+	+6			+1	+3	+1	
Golden plover		+			+	+	+	+
Lesser sand plover		+	+			+	+	+
Whimbrel		+	+	+	+			+
Bartailed godwit		+						
Redshank		+	+		+			+
Common sandpiper		+	+		+	+	+	+
Terek sandpiper		+						
Turnstone								+
Snipe sp.		+			+			
Little stint		?			+			+
Crab plover		+						+
Large Indian pratincole		+						
Eastern blacknaped tern		+	+	+	+	+	+	
Large crested tern		+						
Andaman pompadour pigeon	+	+3	+4	+	+3	+1	+1	+2
Nicobar green imperial pigeon	+	+8	+4		+3	+2	+3	+2
Pied Imperial pigeon		+	+	+	+	+	+	+

Nicobar woodpigeon	+	+1	+?					+1		
Cuckoo-dove	+	+2	+2	+	+2	+2	+2			
Nicobar Emerald dove	+	+2	+1		+3	+2	+2	+3		
Nicobar pigeon	+	+6					+1			
Blyth's Nicobar parakeet	+	+7	+1							
Nicobar red-cheeked parakeet	+	+8	+7	+	+4	?	+3	+		
Brainfever bird		+								
Small cuckoo		+								
Indian cuckoo			+							
Emerald cuckoo		+								
Andaman Koel	+	+8	+7	+	+3					
Andaman greyrumped swiftlet	+	+2	+1		+1		+1			
Whitebellied swiftlet	+	+4	+3	+	+2		+2			
Indian small blue kingfisher		+	+							
Nicobar storkbilled kingfisher	+	+6	+5	+	?1					
Blackcapped kingfisher		+	+		+		?			
White-collared kingfisher	+	+3			+2	+1	+2	+2		
Bluetailed bee-eater					+					
Nicobar greenbreasted pitta	+	+4	+4	+1						
Swallow						+	+			
Brown shrike		+			+	+	+			
Nicobar blacknaped oriole	+	+4	+3	+	+4	+3	+2	+2		
Nicobar racket-tailed drongo	+	+7	+4	+				+1		
Glossy tree stare	+	+6	+5	+	+4	?	+2	+3		
Katchall whiteheaded myna	+							+2		
Nicobar hill myna	+	+8	+5		+1	+1	+2	+1		
Nicobar pied cuckoo-shrike	+				+2					
Ashy minivet					+1					
Andaman red-whiskered bulbul	+				+5	+5	+4	+4		
Nicobar bulbul	+				+2		+1	+2		
Slaty flycatcher		+1								
Paradise flycatcher	+	+1			+2			+1		
Nicobar blacknaped sunbird	+	+4	+2		+2		+2	+1		
Malay streaked fantail warbler					+	+	+			
Great reed warbler		?								
Nicobar ground thrush	+							+1		
Grey wagtail		+	+		+					

Forest wagtail			+					
Nicobar olivebacked sunbird	+	+8	+6	+	+4	+4	+3	+4
Nicobar yellowbacked sunbird	+	+6	+3	+				
Nicobar white-eye	+	?1					?1	+1
Nicobar whitebacked munia	+				+2	+1		

B= Endemic to Andaman & Nicobar; GN=Great Nicobar, LN=Little Nicobar, PM= Pilo Milo, CA= Camorta, TR= Trinkat, NA= Nancowry, KA= Katchall. Numbers besides + = abundance ranking (based on sightings and calls heard) where 1= one, 2= 2-5, 3= 6-10, 4= 11-25, 5= 26-50, 6= >50, 7= >100, 8= >200.

Table 7.

Distribution of avifauna within the Andaman group of islands

Species	E	S	N	M	L
Indian Shag			+		
Little green heron		+	+		
Indian Pond heron		+	+		
Cattle egret		+	+		
Large egret		+	+		
Intermediate egret		+	+		
Eastern reef heron		+	+		+
Andaman teal	+		+3		+1
Andaman blackcrested baza	+		+2		
Sparrow hawk		+	+		
Andaman crested hawk-eagle	+	+1	+1	+1	
Whitebellied sea eagle		+	+		+
Burmese crested serpent eagle			+		
Andaman pale serpent eagle	+	+1	+2		+1
Andaman dark serpent eagle	+	+3	+4		+3
Andaman bluebreated banded rail	+	+2			
Andaman banded crake	+	+1			
Andaman whitbreasted waterhen	+	+4			
Malay moorhen			+		
Golden plover		+	+		
Large sand plover			+		
Little ringed plover					+
Lesser sand plover		+	+		+
Curlew		+	+		+
Redshank		+			
Greenshank		+			
Terek sandpiper		+	+		
Common sandpiper		+	+		+
Turnstone		+			+
Javan gullbilled tern				+	
Roseate tern				+	+
Eastern blacknaped tern		+		+	+
Sooty tern				+	+
Noddy tern				+	
Andaman Pompadour pigeon	+	+2	+3	+1	+2
Andaman green imperial pigeon	+	+5	+5	+3	+4
Andaman wood pigeon	+	+2	+2	+2	+3
Andaman cuckoo-dove	+	+2	+2		+2
Burmese red turtle dove		+	+	+	+
Ring dove		+		+	
Andaman Emerald dove	+	+1	+2		+2
Nicobar pigeon			+		
Large Andaman parakeet	+	+2	+3	+2	
Andaman redbreasted parakeet	+	+4	+5	+2	+5
Andaman redcheeked parakeet	+	+3	+2	+3	+3
Indian lorikeet		+	+	+	+

Drongo cuckoo		+			
Cuckoo		+	+	+	
Himalayan cukoo		+	+		
Small cuckoo			+		
Emerald cuckoo			+		
Violet cuckoo		+			+
Andaman Koel	+	+1	+2		+1
Andaman crow pheasant	+	+4	+4	+2	+3
Jungle nightjar		+	+		
Andaman longtailed nightjar	+	+1			
Whitebellied swiftlet	+	+2	+3	+2	+1
Brownthroated spinetail swift		+	+		
Indian small blue kingfisher		+	+		
Andaman three-toed kingfisher	+				+1
Andaman storkbilled kingfisher	+	+3	+2		
Andaman ruddy kingfisher	+	+1			
Andaman whitebreasted kingfisher	+	+4	+4	+1	+1
Blackcapped kingfisher			+		
Andaman whitecollared kingfisher	+	+3	+3		+2
Andaman chestnutheaded bee-eater	+	+2	+2	+1	+2
Andaman broadbilled roller	+	+2			+1
Andaman black woodpecker	+	+2	+4	+2	+3
Andaman spottedbreasted piedwp	+	+1	+3		+2
Swallow			+	+	+
Javan house swallow				+	
Brown shrike		+	+	+	+
Andaman blacknaped oriole	+	+3	+4	+2	+4
Blackheaded oriole	?	+	+		
Large Andaman drongo	+		+3	+1	
Small Andaman drongo	+	+3			+4
Andaman racket-tailed drongo	+	+4	+5	+3	+3
Whitebreasted swallow shrike	+	+1	+2	+1	+2
Andaman glossy stare	+	+4	+4	+3	+4
Andaman whiteheaded myna	+	+4	+4		+2
Indian myna		+			
Andaman hill myna	+	+3	+4	+2	+4
Andaman tree pie	+	+2	+2	+1	+1
Eastern jungle crow		+3	+2	+1	+2
Andaman large cuckoo shrike	+	+3	+3	+2	+2
Barred cuckoo shrike	+		+1		
Andaman scarlet minivet	+	+2	+3		+2
Eastern small minivet	+	+1	+4	+1	+2
Fairy blue-bird		+	+	+	+
Andaman blackheaded bulbul	+	+1	+2	+3	+3
Andaman red-whiskered bulbul	+	+4	+4	+3	+5
Brown flycatcher		+			
Andaman blacknaped monarch	+	+2	+1	+1	+4
Mangrove whistler		+	+		+
Andaman palefooted bush warbler	+	+1			
Pallas's grasshopper warbler		+			
Assam reed warbler		+	+		+

Eastern great reed warbler		+			
Siberian yellowbrowed l.w.		+			
Largebilled leaf warbler		+	+		
Andaman magpie-robin	+	+4	+2	+2	+2
Andaman shama	+		+1		+2
Andaman ground thrush	+		+1		+1
Forest wagtail			+	+	
Grey wagtail			+	+	
Andaman flowerpecker	+	+3	+4	+2	+3
Andaman olivebacked sunbird	+	+2	+3	+2	+3
Nicobar white-eye	+	+2	+1		
House sparrow		+			

E= endemic, S= South Andamans, N= North Andamans, M= Middle Andamans, L=Little Andaman.

Human Interference in the Habitats of Cranes in Bhutan And Ladakh

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Introduction

The Black-necked Cranes *Grus nigricollis* breed and spend the summer months in China, Ladakh and Tibet. They spend the winters in Bhutan and Southern parts of China and Tibet. They no longer come to the Apa Tani valley in Arunachal Pradesh due to human interference and destruction of their habitat.

Periodic censuses in their known breeding and wintering areas indicate that their numbers are decreasing in some areas. This is mainly due to the destruction of their habitat by humans.

A 6-months winter study in Bhutan and a 6-weeks study during summer in Ladakh brought out the direct and indirect interference in their habitat by humans and its effect on the Crane population.

This paper describes briefly the main problems created by human interference in their habitat, what must be done by the Governments, NGOs and the common man, if these birds are to be seen in their natural habitat by future generations.

Interferences In Bhutan

Draining of Wetlands

There are 3 main wintering areas for these Cranes in Bhutan, ie., Phobjikha in the West, Gyetsa and Thangby vallies in the middle and Bumdiling in the East. Human population in these areas has been increasing and the number of new houses being built every year is a clear indication of this. Along with this, the cattle and sheep population has also been increasing due to the good work being done by the Animal husbandry department.

Naturally, the areas under cultivation and pasturelands have also been increased to provide food and fodder. This has been achieved by draining the wet and marsh lands which are the feeding areas of the Cranes which reduces the availability of food for the birds.

Tourism

All the roosting areas except Bumdling are now directly and easily accessible by vehicles. With the publicity given to the Black-necked Cranes and their roosting areas, the number of tourists visiting these areas are increasing rapidly. Many of them disturb the Cranes, intentionally or otherwise, when they persist in taking a closer look or try to take better photographs.

Barbed wire Fences

The other problem created by man are the barbed wire boundary fences. Lately, they have come up around the fields in fairly large numbers. They have replaced the traditional Pine wood stakes and scantlings. The wooden fences were clearly visible from far but the barbed wire strung across angle iron pickets are not. This change has resulted in damaged wings in some Cranes, especially during take off.

Farm Tractors

Under the old traditional farming system in Bhutan, fallen grains from the harvest in Oct. were left undisturbed in the fields until Apr, the following year at the end of winter. This provided plenty of food for the wintering Cranes who arrive in Oct. each year. Now, with the introduction of Farm Tractors and the practice of ploughing during the winter months has reduced the availability of food and feeding areas.

Interference In ladakh

Vehicular Traffic

In Ladakh, the breeding areas of the few Black-necked Cranes are in high altitude areas, 3,900-4,160m (14,000-15,000 ft) and human habitation is more or less confined to villages where fresh water is available closeby. All agricultural holdings are in and around the villages.

In the olden days, an occassional traveller went past the nesting areas along the existing bridle path and this in no way disturbed the nesting or roosting Cranes. Now, with the improved road communications and vehicles with cross country capabilities, the number of noisy vehicles coming close to their breeding and roosting areas have increased and they are disturbed often.

'Ownerless dogs'

During the summer of 1992, out of a total of the 17 Black-necked Cranes that came to Ladakh, 4 pairs nested and out of the 8 eggs laid, 2 were destroyed by dogs or predators. Out of the 6 chicks, 4 were eaten by dogs. Finally, only 2 juveniles accompanied their parents to their wintering areas. Thus, India's contribution to the world population of Black-necked Cranes in 1992 was just 2 !!

'Ownerless' dogs are a new phenomenon in Ladakh. With the establishment of new military and para-military camps and out- posts and with the availability of food and shelter at these places, some local dogs have attached themselves to these camps. They are now a menace in Ladakh and there have been instances where small children were badly bitten by some of these dogs. As they are able to swim, they can easily get across small, wet gaps and reach the islands where these Cranes nest and eat their eggs and chicks.

Tourism

There was a recent report that Ladakh will be opened to all tourists. This will have an adverse effect on the Cranes breeding and roosting in Ladakh. They will have to be protected from inquisitive and inconsiderate tourists to ensure that they continue to breed in Ladakh. They are very shy and sensitive birds and if disturbed, they will abandon their nests.

Religion and Tradition

It must be recorded that Black-necked Cranes have found a place in the local folklore and the sentiments of the people. While the birds themselves are not threatened directly because of the religion which is Buddhism, there are clear visible signs of encroachment and destruction of their habitat both in Bhutan and Ladakh.

Action Needed

Government department concerned, Non-governmental Organisations and the common man, whether a resident of those areas or a tourist, must ensure that these Cranes and their habitat are not disturbed in any way. They should be allowed to lead their normal life.

Short and long term plans to protect the Cranes and their habitat has to be prepared and implimented with regular monitoring.

Protection must be provided to the birds, particularly the nesting ones and conversion of marsh and wet lands must be stopped.

Army and para-military units and men deployed in these areas should be involved in plans to protect the Cranes and their habitat, besides maintaining accurate data and recording all sightings.

"Ownerless" dogs destroying eggs and chicks must be culled if the breeding rate in Ladakh is to be improved.

The present system of appointing part-time guards during the season to lookafter the Cranes is not satisfactory. Full time wildlife staff should be responsible for this and they can record accurate data on the Cranes and ensure that the birds are not disturbed by inconsiderate visitors.

Educating the people to create an awareness among the people about the urgent need to protect the Cranes and their habitat is the final answer. Once this is achieved, it will be easy to get to get their active involvement in any conservation plan and it will be effective and easy.

Conclusion

The disappearance of the Black-necked Cranes from the Jakhar valley in Bhutan and the Apa Tani valley in Arunachal Pradesh is entirely due to human interference in their habitat. Such interference is still continuing and in fact it is on the increase due to increase in human population. The time to stop this interferenice is now. To save these Cranes from extinction, short-and long-term conservation plans must be implemented. Otherwise, our future generations will see only stuffed specimens in museums. A sad outlook indeed.

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